RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 57 OCTOBER, 1951 No. 4

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GENERAL INFORMATION

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Dural Sinus Venography[1]

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New York, N. Y.

CEREBRAL ANGIOGRAPHY by the injection of contrast medium into the carotid or vertebral arteries provides an adequate and dependable method for the demonstration of the intracranial arterial system. As a result of many detailed studies, the variations of the arterial system of the brain both in the normal and in the diseased state are now well established. On the other hand, studies of the cerebral veins and dural sinuses are few, and their normal and pathological variations are generally unknown. While roentgenograms taken in the so-called venous phase after injection of a contrast medium *via* the arterial route may demonstrate some of the cerebral veins and sinuses, visualization is often incomplete and difficult to interpret.

In an attempt to demonstrate the intracranial venous system more satisfactorily, we have employed several methods of investigation, including (1) direct injection of a contrast medium through a catheter introduced into the anterior third of the superior sagittal sinus; (2) retrograde injection of a contrast medium through a catheter introduced into the basilic vein of the arm and passed upward to the superior bulb of the internal jugular vein; (3) direct measurement of venous pressure in the superior sagittal sinus.

Thus far these methods of investigation have proved of practical value in planning the treatment of certain intracranial tumors and in the diagnosis of other diseases affecting the intracranial venous system. Furthermore, the procedures should be applicable to other types of investigation of the intracranial circulation already in use.

METHOD

Superior Sagittal Sinus Venogram: The patient is placed in the supine position with the head slightly elevated. Local anesthesia is used routinely. A 4-cm. incision is made directly in the midline, centered at the anterior hair line, and a burr hole is made, care being taken not to injure the underlying sinus. Through a small incision in the superior wall of the sinus a No. 8 ureteral or cardiac catheter is inserted and passed backward for 3 or 4 cm. A steady flow of venous blood should be obtained when negative pressure is made on a syringe attached to the catheter. If a good flow is not obtained, the catheter is not in the sinus and should be replaced. Cotton pledgets are then packed about the catheter and the wound is temporarily closed and covered with a small sterile dressing. Saline containing heparin (1 c.c. in 500 c.c. saline) is injected from time

[1] From the Departments of Neurosurgery and Radiology of the New York Hospital-Cornell Medical Center, New York, N. Y. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 5-10, 1950.

TABLE I: RELATIVE FILLING OF TRANSVERSE SINUSES IN NORMAL SUBJECTS

Case	Right	Left
Right dominant (6 cases)	Right	Left
1	Good	Poor
2	Good	Poor
3	Good	Poor
4	Good	0
5	Good	0
6	Good	0
Left dominant (6 cases)		
7	Poor	Good
8	Poor	Good
9	Poor	Good
10	Poor	Good
11	0	Good
12	0	Good
Equal (8 cases)		
13	Good	Good
14	Good	Good
15	Good	Good
16	Good	Good
17	Good	Good
18	Good	Good
19	Good	Good
20	Good	Good

to time to prevent clotting. With a spinal fluid manometer attached to the catheter, pressure readings are made both with the patient at rest and with jugular vein compression.

In the radiology department, the patient is positioned for a lateral examination of the skull and the head is tilted slightly (up to 5 degrees) so that the transverse sinuses will not be superimposed in the resultant film. A rapid injection (duration about two to four seconds) of 15 c.c. of diodrast (35 per cent) or neo-iopax (37 per cent) is made through the catheter and the x-ray exposure follows, at the termination of the injection. There are no symptoms attending the injection save for a transient flushed sensation a few seconds later. Routine roentgenographic technic as employed for cerebral arteriography is satisfactory with 0.5-second exposures at 40 to 100 milliamperes and kilovoltage appropriate to the thickness of the head. Serial radiography utilizing a device such as the Fairchild magazine may be employed to advantage, but is not necessary for adequate diagnostic results. The injection is repeated and a roentgenogram (or serial films) made in the anteroposterior projection. The head should be turned slightly to avoid superimposing the catheter on the torcular Herophili. A 35-degree caudal tube tilt is employed.

In the operating room the catheter is removed and, after bleeding from the sinus is controlled with gelfoam sponge, the wound is closed in the usual way.

Retrograde Jugular Venogram: Local anesthesia is employed routinely. A No. 9 or 10 F cardiac catheter is passed through an antecubital vein and manipulated under fluoroscopic control until the tip lies at the superior jugular bulb. While pressure is made on both jugular veins (manually or by means of a blood-pressure cuff), 25 c.c. of diodrast (70 per cent) or neo-iopax (75 per cent) is injected as rapidly as possible through the catheter. A film (or serial films) is made in the lateral projection at the termination of the injection. An intense generalized flushed sensation and occasionally a throbbing headache follow the injection. These symptoms last for only a few seconds. If a patient has signs of increased intracranial pressure or obviously has a brain tumor, jugular compression should be avoided.

RESULTS

In the normal subject (Fig. 1), the contrast medium injected into the anterior part of the superior sagittal sinus passes rapidly backward through the sinus to the torcular Herophili and thence into the transverse sinuses and internal jugular veins. The other dural venous sinuses and veins do not fill, although occasionally a short segment of a scalp vein and a few diploic veins may be visualized. If the catheter does not completely occlude the lumen of the sinus, some of the contrast medium may pass forward and fill the most anterior part of the superior sagittal sinus and some of the orbital and facial veins. Internal jugular compression, unilateral or bilateral, results only in extensive filling of the vertebral and occipital plexuses of veins and does not alter the basic venous pattern described. Jugular compression, even if prolonged (fifteen seconds), never

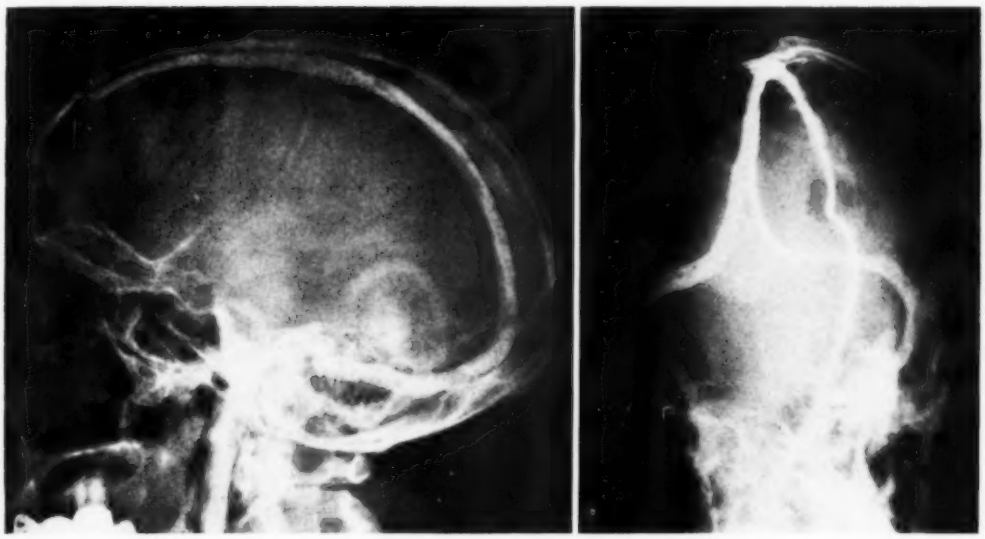

Fig. 1. Normal sagittal venogram after injection of contrast substance into anterior portion of superior sagittal sinus. A (left). Lateral projection. B (right). Antero-posterior projection in another patient.

causes filling of the superior cerebral veins.

In our first group of 20 normal persons, variations in the size and filling of the transverse sinuses were studied (Table I). In 6 cases the right transverse sinus was larger and filled better than the left, while in 6 the left transverse sinus was larger and filled better. In the remaining 8 cases the transverse sinuses were of about equal size and filled equally well. There was no real predominance in size or filling of one or the other transverse sinus in this normal group. Although these findings are not conclusive, the series is large enough to cast serious doubt on the often repeated statement that the right transverse sinus is usually larger than the left and receives most of the blood from the cerebral hemispheres *via* the superior sagittal sinus.

Venous pressure in the superior sagittal sinus in the normal varies between 100 and 150 mm. of saline. It rises promptly on compression of the internal jugular vein and, when the vein is released, quickly returns to the normal level. If the transverse sinus is small, compression of the jugular vein on that side causes only a slight rise in pressure within the superior sagittal sinus. If the transverse sinus is absent, compression of the internal jugular on that side causes no rise in the pressure within the superior sagittal sinus; indeed, the pressure often falls a few millimeters.

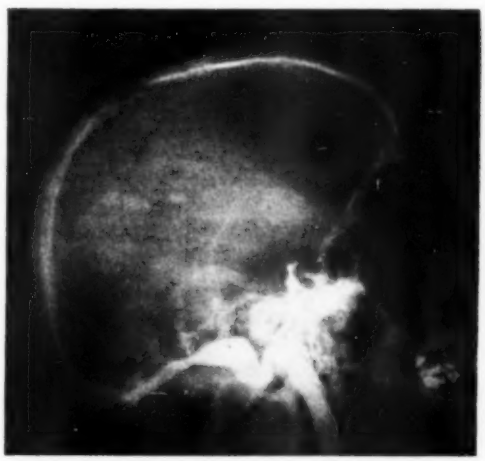

Fig. 2. Normal venogram after retrograde injection of contrast substance into the left superior jugular bulb, lateral projection. There is visualization of the cavernous, superior, and inferior petrosal, and part of the transverse sinus. The mastoid emissary vein is shown.

The retrograde injection of contrast medium by way of a catheter passed

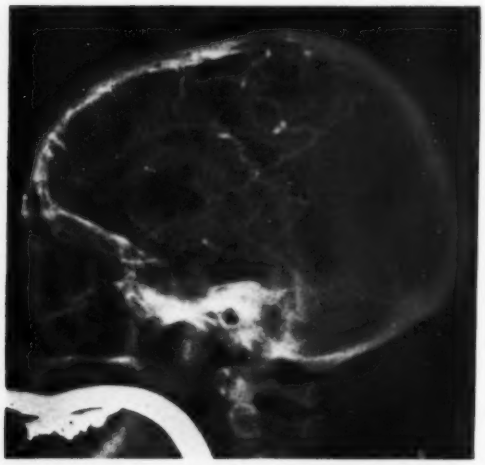

Fig. 3. Case 1: Meningioma invading the superior sagittal sinus. Sagittal sinus venogram, lateral projection. There is complete obstruction of the superior sagittal sinus in its middle third. There is collateral filling of superior cerebral and anastomotic veins on both sides of the head.

through an arm vein to the superior bulb of the internal jugular vein results in filling of the superior and inferior petrosal sinuses and sometimes of the cavernous sinus and transverse sinus of the same side (Fig. 2). There may also be filling of the orbital and facial veins and the pterygoid and vertebral plexuses. The exact extent of filling in the normal is not yet clear, but it appears at present that there should be at least filling of the petrosal and cavernous sinuses and the vertebral and pterygoid plexuses of veins.

Abnormal patterns of the intracranial venous system were obtained in 18 cases, which may be divided as follows:

(1) Meningioma invading the superior sagittal sinus, 5 cases
(2) Sarcoma invading the superior sagittal sinus, 2 cases, and metastatic carcinoma, 1 case
(3) Thrombosis of the superior sagittal sinus, 3 cases
(4) Meningioma invading a transverse sinus, 4 cases
(5) Carcinoma invading a transverse sinus, 1 case
(6) Thrombosis of a transverse sinus, 2 cases

The following case reports are illustrative of the 6 groups.

CASE 1. *Meningioma Involving the Superior Sagittal Sinus:* A 58-year-old woman gave a history of convulsive seizures and progressive weakness on the left side for eight years. Besides a left hemiparesis involving the lower more than the upper extremity, she had impairment of position sense in the left foot and a bilateral Babinski sign. Papilledema was not present, and both the electroencephalogram and cerebrospinal fluid determinations were normal. A pneumoventriculogram showed depression of the mid portion of the body of both lateral ventricles, greater on the right.

A sagittal sinus venogram (Fig. 3) showed obstruction of the sinus in its middle third at about the level of the rolandic fissure. The superior cerebral and anastomotic veins in the anterior half of the head on both sides filled extensively. The anastomotic veins of Trollard and Labbé were especially prominent. The orbital and pterygoid plexuses, cavernous sinus, inferior sagittal sinus, straight sinus, petrosal sinus, and internal jugular vein also filled well. A small amount of contrast medium passed in the posterior third of the superior sagittal sinus, probably by way of collateral venous channels around the point of obstruction.

At operation, a meningioma weighing 75 gm., occupying both sides of the falx, and completely occluding the sinus for a distance of 6 cm., was removed along with the occluded portion of the sinus. Care was taken not to damage the superior cerebral veins entering the sinus anterior and posterior to the resected portion.

For several days after operation the patient experienced weakness of all the extremities, least in the right upper, and also slight aphasia. Recovery of all but the left lower extremity ensued, and there the weakness was less than it had been before operation.

CASE 2. *Sarcoma Invading the Superior Sagittal Sinus:* A 50-year-old white female gave a fifteen-year history of a tumor on the vertex of the scalp. The tumor had been excised thirty times but always recurred. Also, forty x-ray treatments had been given to the lesion over a five-year period. The histologic classification was dermatofibrosarcoma protuberans.

The patient's only complaint during her entire illness was a mild generalized headache. Examination revealed a granular tumor nodule 2.5 × 2.5 cm. directly over the vertex. The surrounding scalp for about 5 cm. was hairless and atrophic. There was no papilledema and no lymph nodes were palpable about the head and neck. Roentgenograms of the skull showed a 4-cm. defect at the vertex. There was no evidence of metastases.

A sagittal sinus venogram (Fig. 4) showed obstruction in the mid portion of the sagittal sinus without

filling of the sinus posterior to the obstruction. There was good filling of the diploic, scalp, and superior cerebral veins anterior to the obstruction. The inferior sagittal and straight sinuses filled well, and by way of these channels some of the diodrast entered the transverse sinuses. Venous pressure in the sagittal sinus was 300 mm. of saline. Pressure on one or both jugular veins for five seconds did not change the pressure in the sinus.

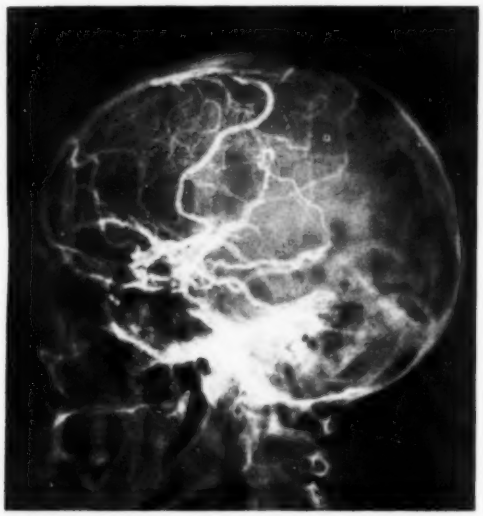

Fig. 4. Case 2: Sarcoma invading the superior sagittal sinus. Sagittal sinus venogram, lateral projection. There are complete obstruction of the superior sagittal sinus and destruction of the skull at the vertex due to a recurrent sarcoma of the scalp. Resultant collateral channels are shown. The inferior sagittal and straight sinus carry contrast substance to the torcular Herophili.

A subsequent craniotomy showed that the tumor had invaded and completely occluded 6 cm. of the middle part of the superior sagittal sinus and also extended for a short distance into several of the superior cerebral veins. These veins were divided beyond the tumor extension and the sinus was divided anterior to the tumor. When the sinus was divided posterior to the obstruction, a 5-cm. "tail" of tumor, unattached to the sinus walls, was found to extend backward in the lumen of the sinus toward the torcular Herophili. It was readily lifted out. The segment of sinus resected measured 6.5 cm. The dural and scalp defects were repaired with suitable grafts and, but for slight transient weakness in both lower extremities for a few days, recovery was uneventful.

CASE 3. *Thrombosis of Superior Sagittal Sinus:* A 48-year-old female gave a six-month history of headache, diplopia, and gradual loss of vision. Except for bilateral papilledema, the physical examination was unremarkable. The cerebrospinal fluid pressure was 480 mm. of saline. Repeated cultures of the spinal fluid were negative. Ventriculograms showed small ventricles without displacement. Bilateral subtemporal decompressions were performed, but the patient continued to lose vision and signs and symptoms remained unchanged over an eight-month period.

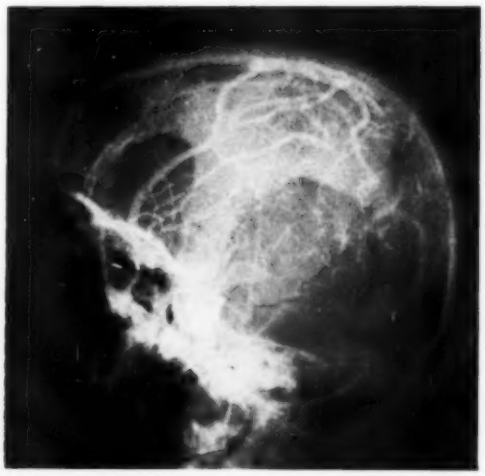

Fig. 5. Case 3: Thrombosis of the superior sagittal sinus. Sagittal sinus venogram, lateral projection, showing obstruction of the superior sagittal sinus in its posterior one-third, the resultant collateral venous pathways being well filled. At operation, a thrombus which had caused the obstruction was removed.

A sagittal sinus venogram (Fig. 5) showed obstruction of the sinus at the junction of the posterior and middle third. There was good filling of the superior cerebral veins anterior to the point of obstruction but none of the contrast medium entered the posterior third of the superior sagittal sinus. The inferior sagittal sinus, straight sinus, diploic veins, and anastomotic scalp veins also were filled. Venous pressure in the sagittal sinus was 480 mm. of saline.

A retrograde jugular venogram on the right side showed filling of the internal jugular vein only. None of the contrast medium passed into any of the intracranial veins or venous sinuses. Pressure in the right internal jugular vein (superior bulb) was 32 mm. of saline.

A retrograde jugular venogram on the left side showed good filling of the superior and inferior petrosal and cavernous sinuses, orbital veins, pterygoid plexus, vertebral veins, and deep facial veins. Because of technical difficulties venous pressures were not obtained.

Several weeks later the posterior third of the superior sagittal sinus was exposed and a thrombus which completely occluded the sinus was removed with suction and forceps until a brisk flow of blood was obtained from both directions.

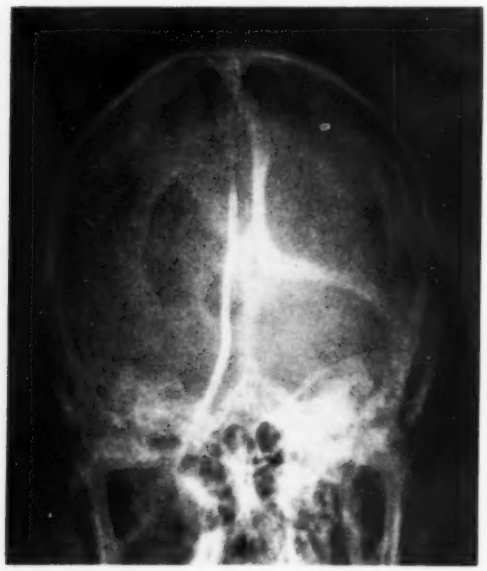

Fig. 6. Case 4: Meningioma invading the right transverse sinus. Sagittal sinus venogram, anteroposterior projection. The left transverse sinus is large and well filled. There is sharp complete obstruction of the right transverse sinus at a point 1 cm. from the torcular Herophili. The superior cerebra veins are not filled.

The patient was given anticoagulant therapy (heparin and dicumarol) for three weeks postoperatively and steadily improved. Her spinal fluid pressure fell to 200 mm. of saline in a week; three months after operation it was normal. Her papilledema and diplopia disappeared and she had headache only occasionally.

Six weeks after the operative removal of the clot, the sagittal sinus venogram was repeated. The venous pressure in the sinus had fallen to less than 300 mm. of saline. The venograms showed a block in the same part of the sinus as before, but filling of the superior cerebral veins and anastomotic veins had greatly increased. The patient was discharged from the hospital and at the time of this report had remained well about five months.

CASE 4. *Meningioma Invading a Transverse Sinus:* A 32-year-old white female gave a five-year history of right occipital headache. Four years previously an "osteoma" had been removed from the occipital region. During the past year a mass had reappeared at the same site. Examination was unremarkable save for a firm mass 5 × 3 cm. in the right occipital region.

Plain skull roentgenograms showed a bony defect 3 × 5 cm. in the right occipital region. A superior sagittal venogram (Fig. 6) revealed a complete obstruction of the right transverse sinus 1 cm. distal to the torcular Herophili. The left transverse sinus was large and filled well. The pressure in the sagittal sinus was normal.

At operation a 50-gm. meningioma, which had completely occluded the right transverse sinus, was removed along with the involved portion of the sinus. Following operation the patient made an uneventful recovery.

CASE 5. *Carcinoma Involving a Transverse Sinus:* A 63-year-old male gave a five-year history of multiple epidermoid carcinomas of the head and neck.

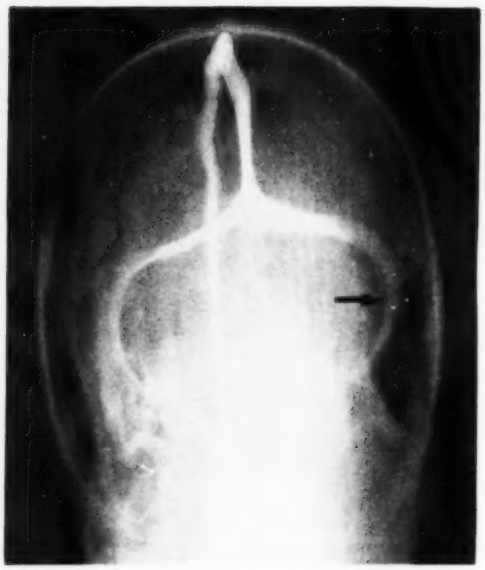

Fig. 7. Case 5: Carcinoma invading the left transverse sinus. Sagittal sinus venogram, anteroposterior projection. There is a filling defect (arrow) of the left transverse sinus. At previous operation, an epidermoid carcinoma of the scalp had been found invading the left transverse sinus.

On admission he had a large ulcerating carcinoma over the left mastoid region extending into the external auditory canal, the mastoid cells, and the middle ear. At operation the tumor was found to have extended into the dura of the middle fossa. In an attempt to evaluate the actual intracranial extension of the tumor, a sagittal sinus venogram was obtained.

The venogram (Fig. 7) showed good filling of the superior sagittal and both transverse sinuses, the left being slightly larger than the right. In the most lateral portion of the left transverse sinus was an irregular filling defect indicating invasion of the lumen by tumor. The operation which had been performed prior to venography had strongly suggested this possibility.

CASE 6. *Thrombosis of a Transverse Sinus:* A 60-year-old man had a three day history of right-

sided earache, headache, chills and fever, and increasing drowsiness. Examination revealed a right facial palsy and tenderness over the right mastoid. There were 500 polymorphonuclear cells per cubic millimeter of spinal fluid. The spinal fluid pressure was not elevated. The Tobey-Ayer test indicated a block on the right side. Skull roentgenograms demonstrated complete destruction of the mastoid cells on the right.

A superior sagittal venogram (Fig. 8) showed good filling of both transverse sinuses. There was, however, an obstruction in the sigmoid portion of the right transverse sinus and none of the contrast medium passed beyond this point. Venous pressure in the sagittal sinus was 200 mm. of saline. A radical mastoidectomy was performed the following day and a large amount of necrotic bone and pus was removed. The sigmoid portion of the transverse sinus was exposed, and a large thrombus was found in the position indicated by the sagittal venogram.

In all abnormal venograms the findings were confirmed by subsequent craniotomy. In no case were we led to a mistaken diagnosis by the venogram.

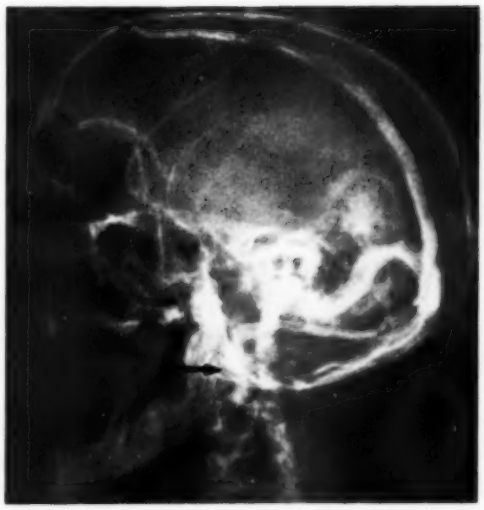

Fig. 8. Case 6: Thrombosis of right transverse sinus. Sagittal sinus venogram, lateral projection. Both transverse sinuses are well filled, but there is complete obstruction of the sigmoid portion of the right transverse sinus (arrow). Confirmed at operation.

DISCUSSION

There has been sporadic interest in the dural venous sinuses among neurosurgeons who have to deal with situations requiring possible removal or ligation of these sinuses during operations. Woodhall (1), in 1939, reviewed the anatomy and embryology of the dural sinuses and was able to show that the presence and relative size of the transverse sinuses could often be determined by plain skull roentgenograms. He stressed the importance of obtaining this information when dealing with neoplasms or other diseases involving the sinuses.

Dandy (2) in 1940 reported 4 cases in which parts of the superior sagittal sinus were resected in the course of removal of brain tumors and collected 9 other cases from the literature. He was primarily concerned with whether the sinus could be resected safely. He concluded that a sagittal sinus which had been gradually occluded by tumor could be resected without particular danger. On the other hand, he was unable to find any evidence that a patent sagittal sinus could or could not be resected without danger.

Gius and Grier (3) have studied the complications and possible venous adaptations after bilateral internal jugular ligation and have refocused attention on the vertebral veins as a compensatory venous bed, as originally pointed out by Batson (4) in a valuable study in 1940. They found that in some patients compensatory circulation does not develop as well as in others and that a chronic state of partial venous obstruction may ensue, with engorgement of the face and neck and increased intracranial pressure with papilledema.

Beck (5) and his co-workers have recently introduced an arteriovenous fistula between the carotid artery and the internal jugular vein as a means of increasing the blood supply to the brain. This procedure has aroused much interest in the dynamics of the cerebral circulation and the changes following establishment of such a fistula.

Dural sinus venography, while hardly answering all the questions relating to the intracranial venous system, is certainly an aid in a variety of circumstances and has served to clarify some hitherto obscure problems.

Only five previous reports of injection of contrast medium into the dural sinuses in man have been found in the literature. Dixon (6), in 1934, injected neoskiodan into a sigmoid sinus and believed he had

demonstrated a thrombosis. Frenckner (7) in 1936 injected perabrodil into the superior sagittal sinus just above the torcular Herophili. In one case he was able to demonstrate a thrombosis of a transverse sinus but in another instance he was misled into operating on a supposedly thrombosed lateral sinus which actually was a normal transverse sinus of small caliber which had failed to visualize. Ellis (8) in 1936 injected perabrodil into the superior sagittal sinus through the open fontanelle of an infant and thought he demonstrated thrombosis of the sinus. His illustrations, however, show contrast substance at the site of injection five minutes after its introduction, so it is probable that most of the contrast substance was deposited outside the sinus. Sicard (9) is said by Orley to have injected lipiodol into a dural sinus, but the injection of an oily substance into the circulation is not a safe procedure.

Scott (10), in 1949, injected diodrast into the sagittal sinus of an infant through the open fontanelle and believed that he demonstrated a block in the posterior portion of the sinus. His illustrations show the superior sagittal sinus well outlined but in the light of our present study it appears unlikely that the sinus was blocked.

All of these workers were handicapped in the interpretation of their results by the lack of studies on the normal venous sinus pattern and its variations as demonstrated by the injection of a contrast substance.

The use of a catheter for the injection of contrast medium into the superior sagittal sinus has in every way facilitated the procedure. The patient may be moved about and his head may be positioned for a variety of roentgen exposures, for, once the catheter is securely in place, there is almost no danger of it being dislodged or perforating the opposite wall of the sinus. On several occasions the catheter was passed backward for the full length of the sinus.

So far, nothing has occurred to indicate that any special risk attends this procedure. It has now been performed on 38 patients. Postoperatively in 2 cases there was a collection of serous fluid in the wound, which was drained and promptly healed. Early in this work diodrast was inadvertently injected outside the sinus into the subdural space in 2 cases with no untoward result save a moderately severe headache for twenty-four hours. If, after the catheter is in place, the operator takes the simple precaution of being sure of a steady flow of venous blood before any injection is made, this accident can be obviated.

The procedure has the added advantage of not requiring elaborate roentgen equipment or any special device. Ureteral catheters of the type used for retrograde pyelography are adequate. Probably any stiff catheter of suitable caliber would suffice. The necessary x-ray equipment is standard for most hospitals. Serial radiography, such as that obtained with the Fairchild magazine, while offering a distinct advantage in the study of venous dynamics is not necessary for practical results.

At present the most important uses to which this procedure may be put are the demonstration of obstruction or partial obstruction of the major dural venous sinuses by neoplasm or thrombus. In the case of neoplasm, it is of utmost importance to determine, before operative intervention, whether an adjacent venous sinus is encroached upon or occluded. If the sinus is occluded, a radical extirpation of the neoplasm together with the occluded or invaded portion of the sinus is possible with safety. This is true whether the sinus involved be the superior sagittal sinus or a dominant transverse sinus. It appears that if the occlusion of a sinus by a neoplasm takes place gradually, over a prolonged period of time, there is ample opportunity for collateral venous pathways to develop. On the other hand, resection of a patent superior sagittal sinus, except in its anterior third, or a dominant transverse sinus is dangerous and may be followed by coma and death.

With the information which sinus venography provides, the operative management of certain difficult cases has been simplified (11). In six cases we have re-

sected portions of the transverse sinuses and the superior sagittal sinus, including its posterior third, without ill effects. If a sinus is only partially occluded, it is now our policy to remove the bulk of the tumor and leave the sinus intact. The venogram is repeated at later dates; when complete obstruction is demonstrated, resection of the involved portion of the sinus can then be performed safely.

Sagittal sinus venography has helped clarify the symptom complex variously called pseudotumor cerebri, serous meningitis, and otitic hydrocephalus (12). This peculiar syndrome is characterized chiefly by increased cerebrospinal fluid pressure, papilledema, headache, and diplopia. Neurologic examination fails to reveal localizing signs, and pneumoventriculograms show normal or small ventricles without displacement. Most of the patients recover in six to eight weeks, but some go on to a prolonged illness, and the increased intracranial pressure may lead to serious loss of vision. Many and varied disease processes have been advanced as possible causes of this syndrome.

We have had an opportunity to study 4 cases of this condition by dural venography. In 3 cases there was an obstruction of the posterior third of the superior sagittal sinus. In Case 3 (reported here) the posterior third of the sinus was explored and a thrombus removed. Following this procedure, the patient improved and is now well one year after the operation. In the fourth case the signs and symptoms of pseudotumor developed following a severe mastoid infection. Dural venography demonstrated occlusion of the ipsilateral transverse sinus by thrombus and a very small transverse sinus on the other side. This patient's symptoms were due to obstruction of the main channel for venous outflow from the brain by a thrombus in the dominant transverse sinus.

Thus far at least, in every case with the signs and symptoms of this syndrome we have been able to demonstrate blockade of the major venous outflow of the brain by superior sagittal sinus venography.

The method of retrograde venography by passing a catheter through a vein in the arm up to the superior jugular bulb has thus far been of limited practical value in the demonstration of diseases affecting the cerebral venous system. In one case we have been able to demonstrate obstruction of an internal jugular vein by this means.

SUMMARY

New methods of study of the intracranial venous system by direct injection of a contrast medium into the dural sinuses have been presented. The results achieved by these methods have proved of value in the study of the anatomy and physiology of the normal intracranial venous system and in the diagnosis and treatment of certain intracranial diseases.

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SUMARIO

Venografía del Seno Dural

Con mira a observar más satisfactoriamente la circulación venosa intracraneal, emplearon los AA. varias técnicas de investigación, incluso inyección directa de una media de contraste a través de una sonda introducida en el tercio anterior del seno sagital superior e inyección retrógrada del medio a través de una sonda introducida en la vena basílica y pasada hacia arriba al bulbo superior de la yugular interna. Descríbese la técnica de ambos procedimientos.

La venografía del seno sagital superior ha resultado útil para descubrir variaciones normales en el tamaño y henchimiento de los senos transversos, para planear el tratamiento de ciertos tumores intracraneales y para diagnosticar otras enfermedades que afectan el sistema nervioso intracraneal. Descubriéronse anomalías del patrón venoso en seis clases de casos: meningioma, sarcoma y trombosis del seno sagital superior y en los mismos estados en un seno transverso. Hasta la fecha se ha utilizado el procedimiento en 38 casos, sin que nada indique que vaya acompañado de mayor riesgo. Posee además la ventaja de no necesitar instalación complicada o aparatos especiales.

La técnica de la venografía retrógrada por medio de una vena del brazo ha mostrado hasta ahora utilidad más limitada, aunque en un caso fué posible descubrir así la oclusion de la yugular interna.

Cerebral Arteriography in General Hospital Practice[1]

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CEREBRAL ARTERIOGRAPHY is an extremely useful diagnostic aid in the study of intracranial lesions. Since its introduction by Egas Moniz, in 1925, he and numerous other workers, in Europe and America, have contributed to the technic and interpretation of the results, to the point that the procedure is no longer in the research or experimental stage.

We started our work in arteriography shortly after the close of World War II. The present series, though not imposing, numbering only 54 cases, is of interest principally for the variety of lesions represented and the accuracy with which they could be diagnosed. It soon became apparent that the technic could be applied to many conditions other than vascular lesions of the brain. The histologic characteristics of tumors and vascular lesions had hitherto escaped roentgenologic demonstration except in a general sort of way, such as recognition of the fairly typical calcification in oligodendrogliomas or meningiomas, and the radiolucent pattern of a dermoid. Ventriculography and encephalography were important advances in the diagnostics of intracranial disease. Cerebral arteriography is a further advance, equivalent in importance.

In our studies we have recognized the limitations of technic and equipment in general hospital practice. Certainly we appreciate that serialographic studies are more accurate and informative than the single studies which we have had to use. These latter, however, are sufficiently accurate for use in any general hospital having adequate neurosurgical facilities and the usual roentgenographic equipment. It is hardly necessary to state that the closest cooperation between the neurosurgeon and the radiologist is imperative.

TECHNIC

The neurosurgeons, Dr. J. J. Keegan and Dr. A. I. Finlayson, have used the percutaneous technic of injection developed by Poppen. A reservoir of normal saline solution is elevated to the ceiling to insure adequate resistance to the systolic blood pressure in the internal carotid artery. The reservoir is connected by means of tubing to a two-way stopcock and the air is evacuated. The needle for arterial puncture is a standard 2-inch 18-gauge intramuscular needle to which a short length of tubing is attached. The head is hyperextended to stretch the skin of the neck and the needle is inserted into the internal carotid artery. When blood flows into the short length of tubing and replaces the air, the tubing is connected to the two-way stopcock. As soon as a free flow of saline solution is established, a syringe containing diodrast solution is connected to the stopcock and the first film is taken with injection of 15 c.c. of the medium. The radiograph is made during the injection of the last 4 c.c. The needle is kept open by perfusion with normal saline solution between injections. A second film is taken for stereoscopic views. Routinely, lateral stereoscopic and a single anteroposterior film are made. Each film requires the injection of an additional 15 c.c. of diodrast. The contralateral carotid artery is compressed during the injection in order to visualize both anterior and middle cerebral arteries on a single anteroposterior film. Failure of filling of these vessels suggests inadequate cross circulation at the anterior portion of the circle of Willis. A Lysholm grid is used instead of a Bucky because it allows greater ease in positioning of the film with the patient on the table.

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[1] From the University of Nebraska College of Medicine. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 5–10, 1950.

INDICATIONS

Vascular lesions of the brain, neoplasms, abscesses, hematomas, and other supratentorial lesions are indications for arteriography. Lesions below the tentorium require injection into the vertebral artery, a much more tedious and difficult undertaking.

While arteriography is not a procedure to be used indiscriminately and inadvisedly, it is less dangerous and less distressing to the patient than air studies, and it is diagnostically accurate.

The contraindications to the use of diodrast for intravenous urography apply also to cerebral arteriography, the chief one being sensitivity to the medium. It has been reported that pentothal anesthesia prevents unfavorable reactions, even in sensitive individuals. Broman and Olsson conducted experiments on the diodrast group of contrast media in high concentration. Assuming that cerebral symptoms followed damage to the normal blood-brain barrier, these workers undertook a study of permeability of the cerebral vessels in the rabbit, cat, and guinea-pig. Injection of the contrast medium in 50 per cent concentration for ten or more seconds as a rule disturbed blood vessel permeability. With concentrations above 50 per cent, disturbed permeability could be demonstrated after an injection of a few seconds. Damage to the blood-brain barrier was accompanied by disturbance of cerebral functions. Moderate disturbance of permeability was reversible within two hours. The following tentative conclusions were reached: (*a*) A 35 per cent concentration of contrast medium is recommended for injection into the carotid and vertebral arteries. In exceptional cases a small amount of 50 per cent solution may be used for one injection. (*b*) A 35 per cent concentration is suggested for percutaneous injections into the common carotid artery. If films prove that the needle is in the common carotid artery, a second injection of 50 per cent medium may be used. (*c*) Regardless of concentration, the injection time should be short and the number of injections should be limited. The general use of thorotrast as a contrast medium in cerebral arteriography is held to be indefensible.

There are contraindications to the procedure which must be weighed against the information to be gained. Advanced cerebral arteriosclerosis, extreme old age, severe cardiorespiratory disease, and a known sensitivity to the contrast medium all come under this category.

Arteriography in the event of a recent cerebral vascular accident is regarded as dangerous by many authors, including Elvidge, Turnbull, and List. Poppen, after reviewing 200 arteriograms in most of which thorotrast had been used, stated that he does not hesitate to inject thorotrast or diodrast at any time in the presence of a recent subarachnoid hemorrhage if an 18-gauge needle is used, since any increased arterial pressure due to the injection is dissipated before the aneurysmal site is reached.

TYPES OF LESIONS REVEALED

1. Vascular Lesions: There is no doubt that serial arteriography with at least five photographs in series showing the arterial, capillary, and venous stages aids considerably in the more accurate diagnosis of intracerebral lesions. Lacking facilities for this procedure, we have roughly timed the injection to obtain films during the most important phase.

Raney, Raney, and Sanchez-Perez, in their discussion of the role of cerebral angiography, state that in the case of congenital arteriovenous aneurysms the ipsilateral carotid artery may contribute to the circulation of the involved hemisphere but that in most instances the circulation is maintained predominantly through collateral channels. In acquired fistulae of the carotid-cavernous sinus variety the demonstration of dye in the general cerebral circulation on the involved side indicates an inadequate collateral circulation. In the presence of arteriovenous communications of all kinds, serial angiography re-

veals rapid blood passage through the cranial cavity because of the short cut in the circulatory system. The blood in these short cuts contributes little to the circulation of the involved area. A retarded cerebral blood flow indicates impending circulatory failure in the involved hemisphere. Raney and his associates point out, also, that in dealing with bilateral aneurysms, bilateral angiocardiography is usually essential for an accurate diagnosis.

In general, it may be stated that cerebral aneurysms can be well demonstrated and that obliteration of vascular channels, either partial or complete, can be identified and localized with a high degree of certainty.

Wechsler and Gross believe that much of the uncertainty as to the diagnosis and prognosis in spontaneous subarachnoid hemorrhage can be dispelled by cerebral arteriography. On the basis of their experience, both in acute and subacute stages of subarachnoid hemorrhage, they state with assurance that injection for visualization of the arteries is a safe procedure. Of a rather small series of 10 cases reported by them, 6 were the result of vascular malformations demonstrated by arteriography, and only 4 were aneurysms. Three of the aneurysms were near the bifurcation of the carotid; in the fourth case, the aneurysm was presumed to have burrowed into the temporal lobe, where it ruptured and caused a large intracerebral hemorrhage. We have films taken on one patient before and after rupture of an aneurysm. This occurred in one of our earliest cases and the radiographic technic was poor.

It seems that recurrent subarachnoid hemorrhages with recovery, with or without sequelae, are more likely to be fatal during the first or second attack. Surgical treatment, whether ligation alone, or in combination with deep irradiation will prevent recurrence in many cases (Wechsler and Gross).

Sanchez-Perez and Carter attach considerable significance to the "liquid segment" (*i.e.*, the opaque substance) which must be followed in its passage through the vascular system of the brain and recorded on the films in different stages. They found that this could be done adequately with six films in four and a half seconds, the time normally required for the liquid segment to travel from the common carotid artery in the neck to the internal jugular vein in the neck. The slowing of circulation, according to these writers, can be of two types, one in which the vascular pathways have been enlarged, as in certain types of arteriosclerosis or in varicosities of the brain; the other in which the blood flow is definitely more sluggish than normal, as in certain congenital vascular malformations, generalized arteriosclerosis with rigidity of the arteries, tumors, or other diseases in which a collateral circulation has been established after a vascular lesion.

Angiograms furnish not only anatomical but also physiological information. Sanchez-Perez and Carter go on to point out the importance of injecting both sides of the brain. Very often two completely independent pathological conditions are present, one in each hemisphere; also, an abnormality in the rate of circulation on one side must be accompanied by a compensatory vicarious and physiologically abnormal condition in the other hemisphere, as in some cases of thrombosis of the internal carotid artery which does not interfere with the circulation through the circle of Willis, and in consequence produces few or no neurological symptoms.

According to Govons and Grant, the incidence of intracranial aneurysm ranges from 0.5 to 1.6 per cent of routine postmortem examinations of the head. Etiologically they classify these lesions as mycotic, arteriosclerotic, and congenital. The mycotic type is rare and the arteriosclerotic uncommon. The majority of intracranial aneurysms occur in the anterior portion of the circle of Willis. These same authors state that angiomatous malformations comprised about 1 per cent of Cushing and Bailey's series of verified intracranial tumors, while Dandy estimated the incidence as 0.5 to 1 per cent of

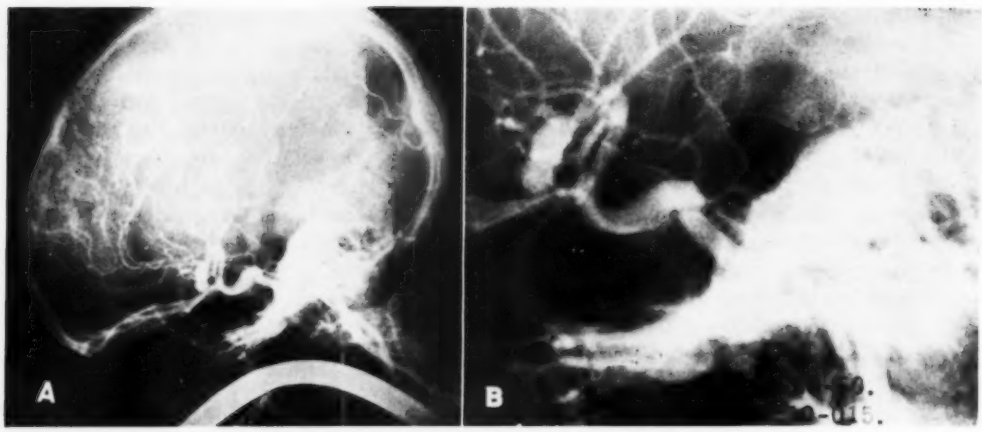

Fig. 1. A. Aneurysm of the anterior communicating artery. B Close-up of aneurysm shown in A.

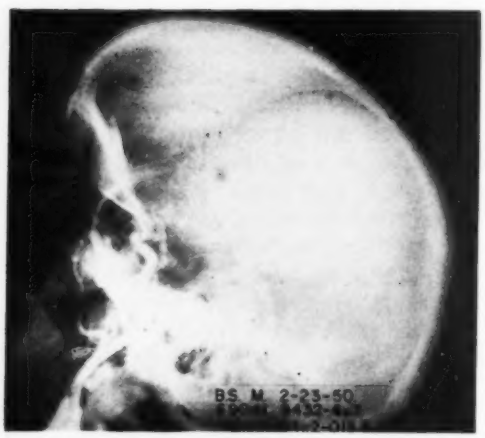

Fig. 2. Aneurysm of the posterior communicating artery. Poor filling of anterior cerebral artery, indicating impairment of its circulation.

cases in clinics in which neurological material is concentrated. Large proportions are found in the distribution of the middle cerebral artery. Thrombosis of the internal carotid artery as a source of neurologic disturbance is often ignored in both clinical and pathological studies. The most frequently associated lesions are aortic sclerosis or pressure from an aortic aneurysm; obliterating syphilitic arteritis without aneurysm, embolisms, and non-syphilitic arteritis have been reported in a few instances (Govons and Grant). A common history is that of transient attacks of hemiparesis progressing to permanent hemiplegia with or without sensory paralysis or aphasia. The creation of a fistula between the carotid artery and the cavernous sinus is commonly the result of cranial trauma, especially when a basilar fracture of the sphenoid bone occurs. The aneurysm is usually unilateral, rarely bilateral, and the symptoms may progress rapidly or slowly.

The vascular lesions from our series illustrated here include arterial aneurysms, arteriovenous aneurysms, arteriovenous malformations of a congenital type, and hemangiomas.

The first case (Fig. 1) is that of a small saccular aneurysm of the anterior communicating artery in a man 31 years of age who was admitted with a history of spontaneous subarachnoid hemorrhage. This lesion was felt to be inoperable because of inadequate cross circulation through the circle of Willis, and carotid ligation was not done. Recurrent hemorrhage later in the month was followed by death.

The second patient was a 42-year-old woman admitted with a history of a spontaneous subarachnoid hemorrhage occurring the night before. Arteriography two weeks later revealed a tiny saccular aneurysm at the origin of the posterior communicating artery (Fig. 2). Carotid compression during injection indicated inadequate cross communication through

the circle of Willis, ruling out carotid ligation. The only remaining surgical approach would be a direct attack on the lesion with an attempt to obliterate it. This was not accepted by the patient or her family because of the rather high risk. She died six months later from recurrent hemorrhage.

A third case is that of a 30-year-old man admitted on Feb. 13, 1948. He had suffered a subarachnoid hemorrhage with hemiparesis in January of that year. An arteriogram obtained on Feb. 23 showed the lesion to be a large saccular aneurysm associated with a mass of dilated vessels, interpreted as arteriovenous malformations. One small area suggested hemangioma (Fig. 3). Ipsilateral common carotid artery ligation was performed, and the patient was alive and well two and a half years later.

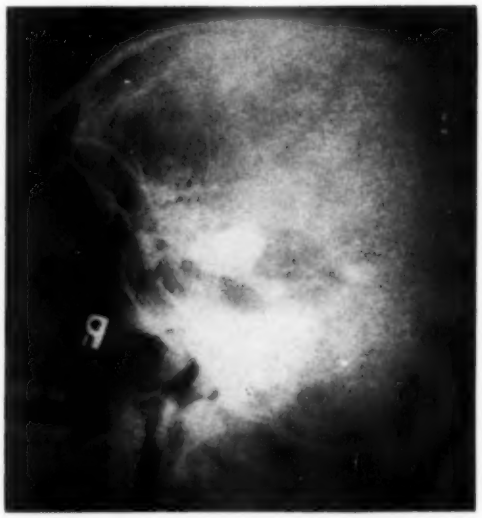

Fig. 3. Large aneurysm in the region of the circle of Willis, associated with large tortuous vessels anteriorly, indicating an arteriovenous malformation.

The next case (Fig. 4) showed a small arteriovenous anomaly just behind the internal carotid artery in the distribution of the posterior communicating artery. This patient had been subject to recurrent epileptiform seizures over a two-year period, and was admitted after suffering a subarachnoid hemorrhage eight days before. The lesion was considered to be inoperable because of its depth and location.

The films in Figure 5 are those of a woman 43 years old whose left eye had been removed at the age of eight and a half months because of a tumor. Three years before she was seen here, she began to experience tremor of the right hand and arm. Plain films of the skull showed dilated vascular markings and erosion of the left side of the sella turcica. An arteriogram revealed a very extensive arteriovenous malformation through which the circulation of diodrast was quite sluggish.

Leptomeningeal angiomatosis (Sturge-Weber syndrome) is an interesting congenital vascular anomaly including hemangioma on the face, usually in part of the

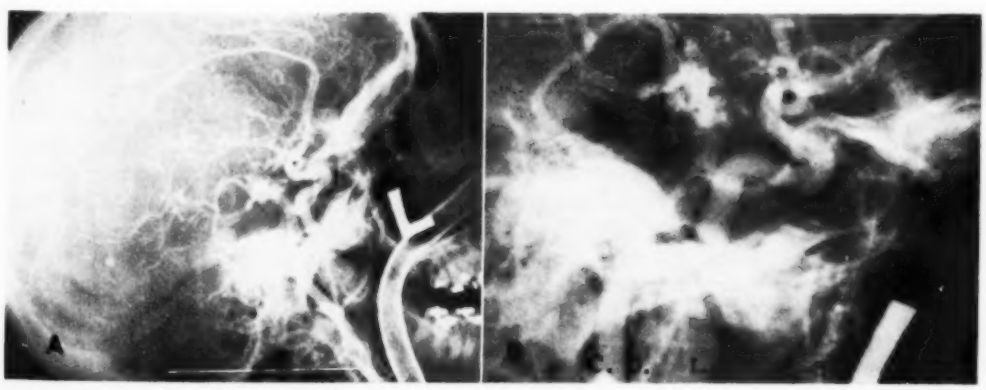

Fig. 4. A. Small arteriovenous malformation of left posterior communicating group. The right arteriogram was normal. B. Close-up of arteriovenous malformation shown in A.

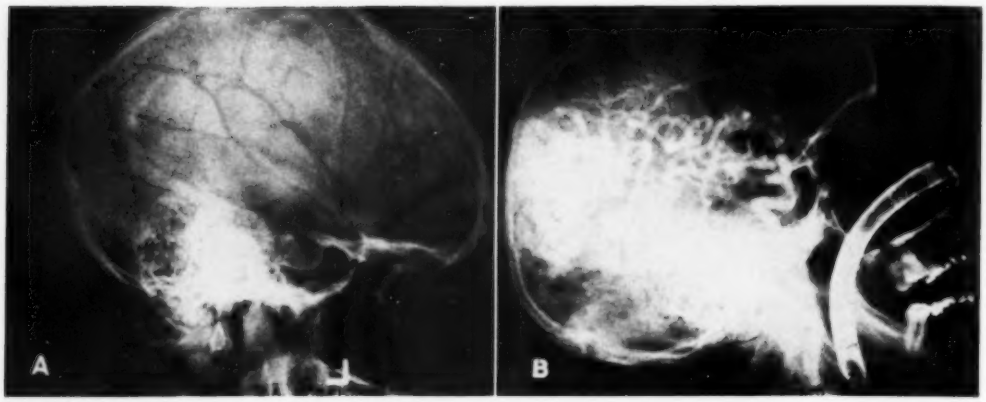

Fig. 5. A. Plain lateral film of the skull in a patient with a large arteriovenous malformation involving the left middle cerebral artery. Note the unilateral bulging of the floor of the sella due to the enlarged internal carotid artery supplying the vascular malformation. B. Arteriogram of patient shown in A. Note the enlarged internal carotid artery supplying the huge arteriovenous malformation of the middle cerebral. There was cross communication, with pooling of diodrast in the occipital region.

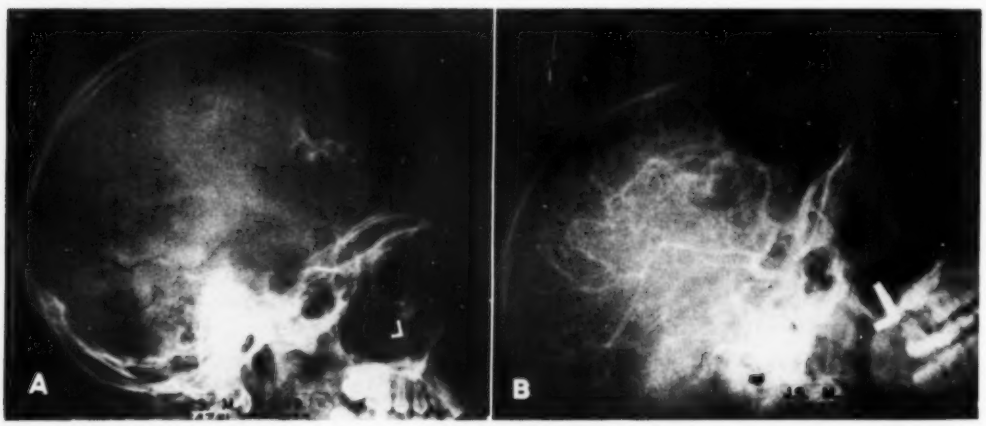

Fig. 6. A. Sturge-Weber angiomatosis with wavy calcification in the cortex. B. Arteriogram in same case, showing no evidence of increased vascularity in the region of calcification.

trigeminal distribution, associated with an arteriovenous angioma of the leptomeninges (Fig. 6). Our patient was a boy of 10 years with a history of recurrent jacksonian seizures. The lesion tends to calcify due to the sluggish circulation. Wavy calcification was shown on the plain films, characteristic of the cortical calcification seen in these persons. An arteriogram was done to eliminate the possibility that serious hemorrhage might result from surgical attack on the brain. The arteriogram was relatively normal, indicating very slow circulation into the vascular lesion, suggesting that intervention would be unaccompanied by serious bleeding. This proved to be the case.

Hematomas can be beautifully demonstrated by arteriography. One patient (Fig. 7) presented a serious problem because of her mental condition. She had previously had a subtemporal decompression, and nothing was found. Arteriography revealed displacement of the vessels of the brain away from the vault, characteristic of subdural hematoma. The edge of the hematoma reached to an area just above the superior border of the de-

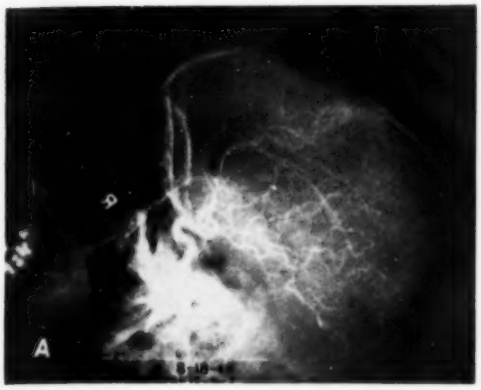

Fig. 7. A. Lateral arteriogram of patient with subdural hematoma. The middle cerebral group shows some downward displacement. B. Anteroposterior view in same case. Note the obvious displacement of the cortical vessels away from the inner table of the vault and slight displacement of the anterior cerebral group to the opposite side.

compression, which explained the negative findings. Following trephining with evacuation of the hematoma, the patient's mental condition returned to normal. It was then that she gave a history of a blow received from a falling sewing machine several months previously, followed by headaches, subjective ataxia, and blind spells for a few weeks prior to admission.

Kristiansen reports on the value of percutaneous cerebral angiography as an aid in the diagnosis of acute head injuries. In general the differential diagnosis includes one or more of the following: extradural hematoma, subdural hematoma, intracerebral hematoma. In subdural hematoma, there is a lack of contrast medium between the skull and surface of the brain, and the anterior cerebral artery is displaced to the uninvolved side. Repeated angiography after removal of the hematoma reveals regression of the cavity and return of the displaced anterior cerebral artery toward its normal position. Kristiansen presented one case in which the cerebral angiogram was normal. In this instance the lesion was probably located in the posterior fossa or posterior occipital region. Because the results of surgical treatment are good in these intracranial hematomas, it is suggested that this method of diagnosis and treatment be employed in suitable cases.

It is Gardner's feeling that arteriography should be used in all cases of jacksonian epilepsy because a high percentage of those cases are due to vascular anomalies and malformations.

2. Cerebral Neoplasms: Two diagnostic features of intracranial neoplasms are brought out by arteriography. One is the displacement of the vessels around the neoplasm. The second is the characteristic vascular pattern of the tumor itself. Serialographic studies are more exact than single or stereoscopic films since demonstration of all phases from arterial to venous is needed to make clear the true picture.

The capillary phase is the most important single phase and we have attempted to delay filming by a second or two in order to obtain films during this stage of filling. List and Hodges published an extensive study not only of vascular anomalies, but also of the blood supply of various tumors, taking up in detail the differential diagnostic features. Other authors have written similarly.

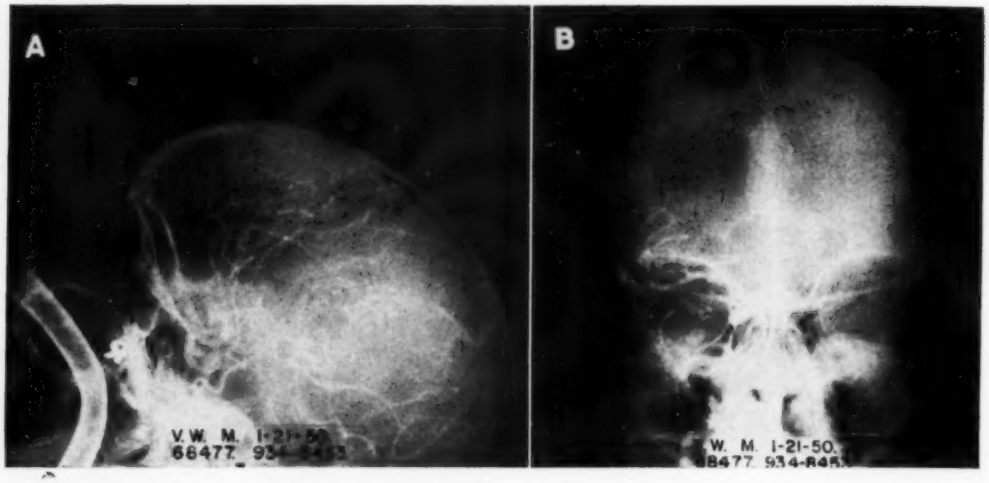

Fig. 8. A. Glioblastoma multiforme of right parietal area. Note the venous channels leading from the tumor area. Circulation elsewhere is in the arterial phase. B. Anteroposterior view of same patient, showing abnormal vascular pattern in right mid parietal area.

The following types have been noted in our series.

Glioblastoma multiforme (Fig. 8) was well outlined by arteriography both as to size and location. This tumor has a characteristic vascular pattern consisting of arteriovenous malformation in association with what appear to be miliary aneurysms. There are usually hypervascularization of the adjacent normal brain and an abundant blood supply within the tumor. Hemmingson, quoted by Green and Arana, has described the following picture, which he states he has never encountered with other tumors. The vessels are irregularly arranged and of varying caliber. Between the vessels there are small irregular spots, which may be miliary aneurysms. In addition there are sometimes arteriovenous fistulas with one or several veins leading from the tumor and demonstrable in the arteriogram (Fig. 11). In one of our cases (Fig. 9) air studies were done before arteriography. Arteriography was not only more exact in locating the tumor, but also demonstrated the characteristic vascular pattern of a glioblastoma multiforme. Air studies revealed only the presence of a unilateral neoplasm with poor filling on the involved side and displacement of the midline structures to the opposite side.

In a strict sense, a *hemangioma* is a neoplasm as distinguished from a vascular anomaly and must be differentiated from glioblastoma multiforme. One of our patients was a 46-year-old man who was subject to recurrent seizures over a five-year period (Fig. 10). Plain films revealed a calcified lesion in the posterior superior frontal region. Arteriograms indicated the area to be avascular and showed no significant displacement of the vessels from their normal location. This finding indicated that the lesion was not a space-taking neoplasm but probably represented an avascular area within an old calcified hemangioma. At operation this proved to be the case.

Meningiomas have a characteristic blood supply and, in addition, show considerably more displacement of the vessels than would be expected from a glioblastoma multiforme, which is a more infiltrating type of growth. Displacement of the vessels about the cystic areas will also be seen in cystic glioblastomas, but these will show the arteriovenous shunt (Fig. 11). In the patient illustrated in Figure 12 a characteristic type of vascular malformation indicating meningioma was found. The vessels were markedly displaced around an area revealing abnormally fine

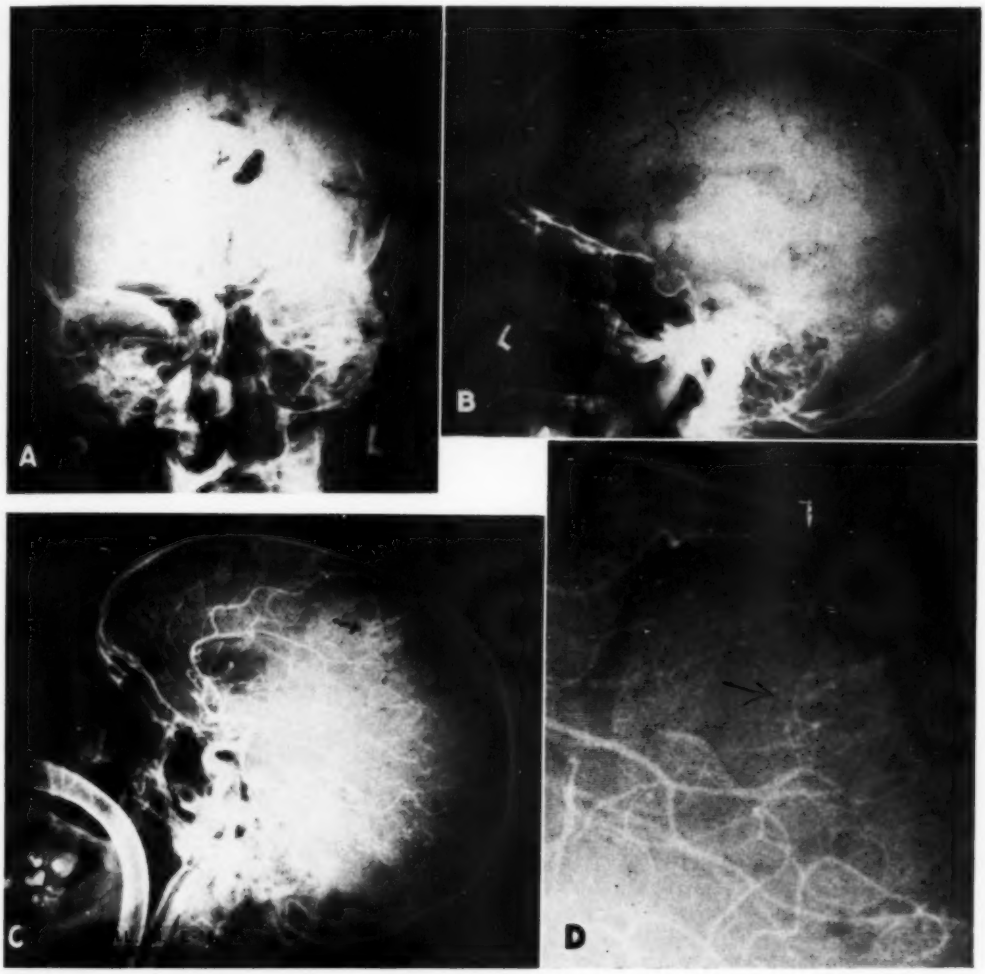

Fig. 9. A. Encephalogram revealing a space-filling lesion on the right, displacing mid-line structures to the left. B. Lateral view of same case, showing narrowing of the lateral ventricle due to depression of the roof of the ventricle, indicating a superior parietal lesion. C. Arteriogram of same patient. Note the localization and the typical vascular pattern indicating glioblastoma multiforme. Localization much more exact than by air studies. D. Close-up, showing characteristic blood supply with miliary aneurysms and distorted vessels without displacement. Note venous channels draining area.

tufted vessels. A comparison of these findings with air studies on another patient having a similar meningioma, both as to size and location, illustrates the ease of identification of the tumor by arteriography as contrasted to encephalography (Fig. 13).

There was one *astrocytoma* in our series, but the findings were equivocal and therefore it is not illustrated here. It was suspected clinically and arteriographically, but not proved until surgical exploration. Arteriograms aided in localizing the lesion, however. Astrocytomas show a relatively scanty blood supply and the angiograms reveal splitting and spreading of the larger and medium-sized cerebral arteries. The finer arterial branches, which are always visible in the normal subject, may be entirely absent. The frequent presence of cysts is the one factor to account for sparseness of the vessels. An angiogram of dif-

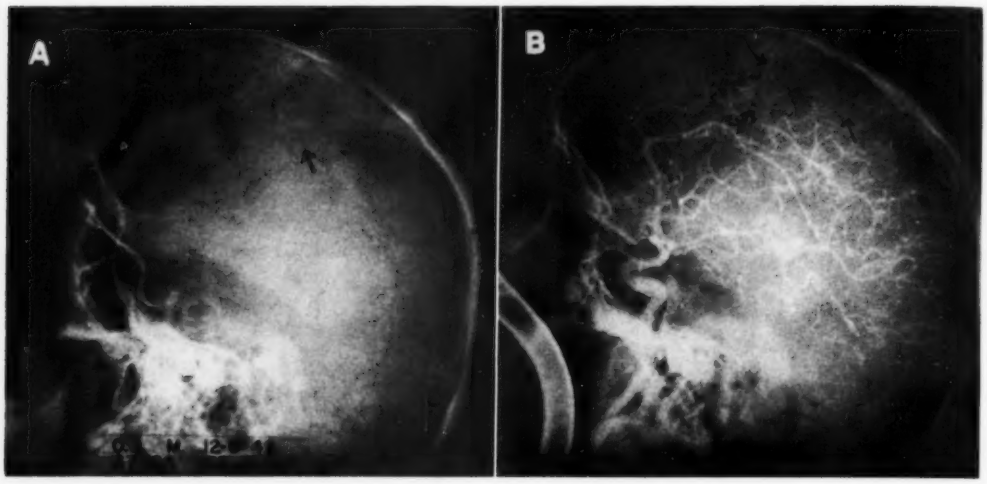

Fig. 10. A. Small area of calcification in the posterior-superior frontal region. Type of lesion indeterminate. B. Arteriogram of same patient, revealing a relatively avascular area with calcium deposit in the center, indicating an area of avascular necrosis. No displacement of vessels to indicate a large tumor.

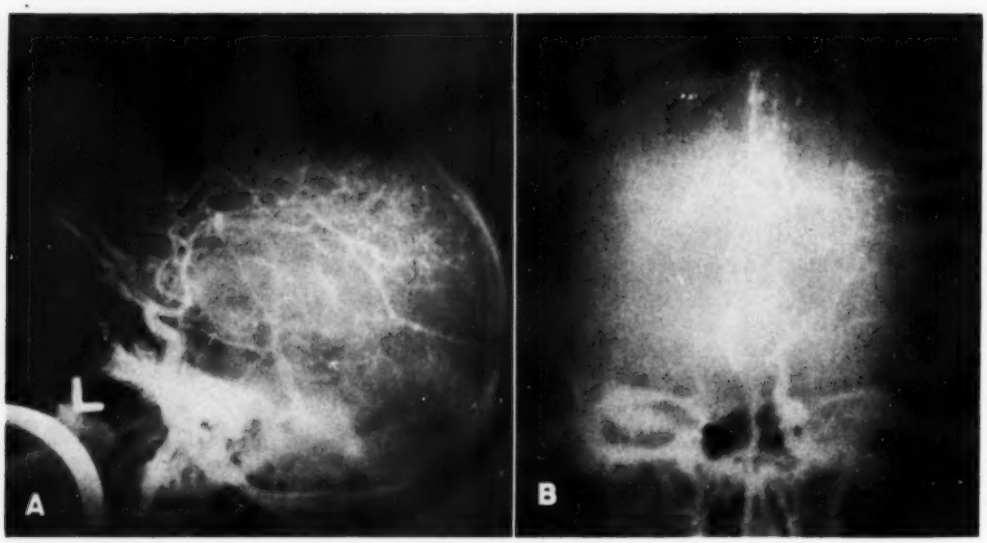

Fig. 11. A. Large cystic glioblastoma multiforme. Note the marked displacement of the vessels, with a large vein coursing downward and posteriorly to the inferior temporal region, draining into the sigmoid sinus. B. Anteroposterior view of same patient. Note the medial displacement of the sylvian group of vessels.

fuse astrocytoma resembles that seen in brain edema, with stretching and angulation of the vessels (List and Hodges).

SUMMARY

1. A report has been made of the findings in 54 patients on whom arteriographic studies were made. Typical cases in this group have been reported and illustrated.

2. The indications and contraindications for cerebral arteriography have been reviewed on the basis of the literature and discussed in the light of our experience.

3. Serialographic studies are admittedly to be preferred, but we have used single films, obtainable with the radiographic

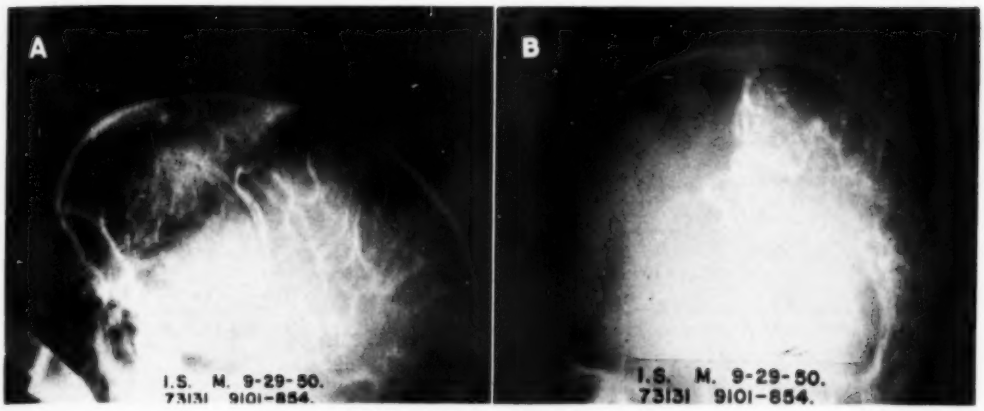

Fig. 12. A. Frontal meningioma. Note marked displacement of anterior cerebral vessels around the tumor and the vascular pattern of the tumor itself. Details are slightly blurred due to convulsive twitching accompanying injection of diodrast under light anesthesia. B. Same case. The tumor area is again localized. The anterior cerebral artery was apparently displaced directly posteriorly, which would indicate tumor on both sides of the mid-line.

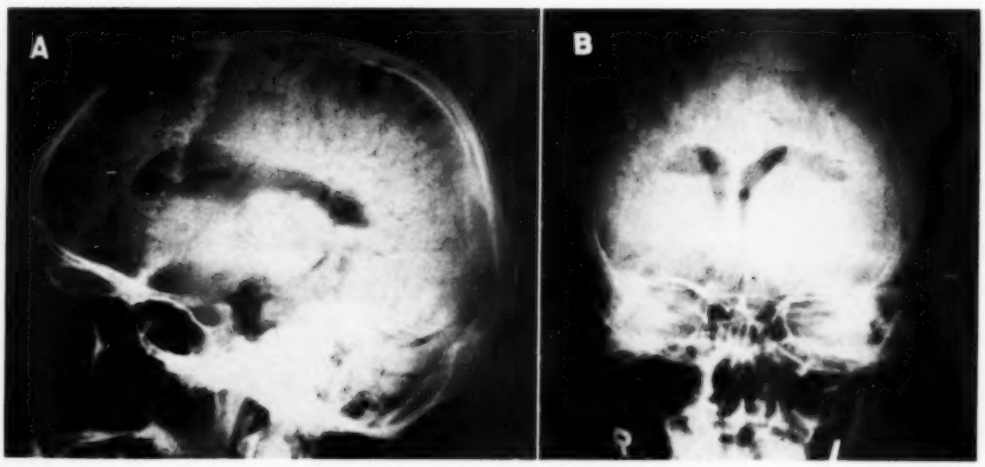

Fig. 13. A. Encephalogram of a frontal lobe meningioma of approximately same size and location as that revealed by arteriograms in Figure 12. The exact size and shape of the tumor cannot be determined as precisely as with an arteriogram. Anteroposterior view of same case, showing lateral horn of left ventricle elevated and displaced to the right.

equipment commonly available in general hospital practice, with a sufficient degree of accuracy to demonstrate the value of cerebral arteriography in the study of intracranial vascular lesions and neoplasms.

4. We recommend that arteriography be utilized with the same discrimination as air studies. It should take its place along with encephalography and ventriculography as a valuable diagnostic procedure in those institutions where neurosurgical cases are commonly seen. We do believe that it is a procedure requiring the cooperative services of the radiologist and the neurosurgeon.

NOTE: The author wishes to express his appreciation for the technical advice and clinical data supplied by Dr. A. I. Finlayson, who performed the majority of the carotid injections, to Dr. J. J. Keegan for his clinical assistance, and to Dr. H. B. Hunt

for his able advice and assistance in the preparation of this paper. The author is indebted also to George Pfau for the photographic reproductions.

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SUMARIO

La Arteriografía Cerebral en los Hospitales Generales

Las lesiones vasculares del cerebro, neoplasias, abscesos, hematomas y otras lesiones supratentoriales constituyen indicaciones para la arteriografía. La principal contraindicación consiste en la sensibilidad al diodrasto. Otras contraindicaciones, que se contrapesarán con el valor de los datos obtenidos con dicho procedimiento, son la arterioesclerosis cerebral avanzada, la senilidad pronunciada y la enfermedad cardiorrespiratoria grave.

Si bien la arteriografía seriada representa sin duda el método de elección para el descubrimiento de las lesiones vasculares, el A., careciendo de los medios para llevarla a cabo, ha logrado excelentes resultados con radiografías aisladas obtenibles con las corrientes instalaciones roentgenográ-

ficas, fijando el momento de la inyección del medio de contraste conforme a si se desea revelar la fase arterial, venosa o capilar del henchimiento.

Preséntase, con ilustraciones, una serie de casos que comprende aneurismas arteriales, aneurismas arteriovenosos, malformaciones arteriovenosas congénitas y hemangiomas.

En las neoplasias cerebrales, los importantes hallazgos arteriográficos consisten en desplazamiento de los vasos circundantes y en el patrón típico del tumor mismo. Preséntanse varios casos.

DISCUSSION

(Papers by Ray, Dunbar, and Dotter, and by Moore)

Harold C. Voris, M.D. (Chicago): These two papers are certainly of great interest to the neurosurgeon as well as to the radiologist.

Dr. Moore and Dr. Hunt are to be congratulated on their clear presentation of carotid angiography, its technics and uses. I can find nothing to quarrel with or dispute in their presentation. I would like to emphasize out of my own experience the value of serial angiography where the equipment is available, particularly in diagnosis and surgical evaluation of intracranial tumors and large vascular malformations. A series of pictures will give you more complete knowledge of blood supply and arterial filling and venous drainage than can be obtained from a single film. However, the majority of angiograms today, I think, are being made without benefit of serial equipment and with satisfactory results.

I am sure that, wherever angiography is used in a neurosurgical clinic, its use will steadily increase not only in cases of suspected vascular lesions but also in cases of tumors. I feel that today, given evidence of an intracranial tumor and lateralizing signs, angiography is not only much less dangerous and distressing to the patient but, as has been pointed out, will often give much more valuable information to the surgeon than air studies. Where intracranial pressure is high and ventriculography carries obvious risks, even bilateral carotid angiography may well be considered.

As the essayists pointed out, the diagnosis of tumors by angiography rests primarily on two points: (1) the characteristic vascular pattern of the tumor, if it has one, and (2), in avascular tumors, the displacement of blood vessels. Both points, of course, are used in interpretation of the individual angiogram.

The technic of Drs. Ray, Dunbar, and Dotter—the visualization of the duro-venous sinuses—is a relatively new one, and I don't suppose it is going to have as wide a use as carotid angiography. It is perfectly apparent that where the surgeon needs to know the patency of the duro-venous sinuses, and whether or not a collateral circulation has been established in cases of occlusion, this method will be invaluable.

As in all new diagnostic technics, new information regarding allied points is not immediately forthcoming. It appears as soon as experience with the technic is developed. Anatomists have known for a long time that there is considerable variation in the size of the lateral sinuses, for example. Perhaps the essayists' demonstration of this angiographically will lead to a little less emphasis by some neurologists on the importance of the so-called unilateral Queckenstedt test. It is also of great interest that they have demonstrated thrombosis of the superior sagittal sinus or the lateral sinus in case of so-called pseudotumor or serous meningitis, a condition which has always troubled the neurological surgeon from both the standpoint of diagnosis and therapeutics.

I would not expect diodrast injected into the venous sinus side of the cerebral circulation toward the heart to be followed by any untoward consequences except as a result of general sensitivity to iodine, and I note that Dr. Ray and his co-workers have not reported any such complication. Carotid angiography with diodrast, on the other hand, does carry such dangers. We think that at Mercy Hospital we have been very fortunate in a low percentage of late or delayed vascular complications following angiography with diodrast. If I may close by emphasizing the precautions that we use, I would like to do so.

Most of our percutaneous angiograms, and for that matter most of the open ones, are carried out under local anesthesia. Whether general anesthesia is used or not, we carry out separately a stellate block on the injected side or, if both sides are injected, a bilateral stellate block, with procaine. This stellate block is repeated in a few hours, usually four to six, and all patients receive 2 grains of papaverine every four hours for six doses. Since these precautions were instituted, we have not had any cases of cerebral thrombosis or vasospasm. We have had only 2 cases of thrombosis in our series of well over 200 angiograms, one in a carotid and the other in a vertebral angiogram, both fortunately non-fatal. I believe that our practice, from the beginning, of using procaine with consequent block of the cervical sympathetic, probably has a lot to do with our relatively low incidence of complications. Both precautions are of particular importance in patients over forty-five, and in those with obvious arteriosclerosis.

Diagnosis of Complete Transposition of the Great Vessels[1]

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San Francisco, Calif.

IN COMPLETE TRANSPOSITION of the great vessels the aorta arises from the right ventricle and the pulmonary artery from the left ventricle. There are thus two closed circulations: in one the systemic blood enters the right heart from the vena cava and returns directly to the systemic circulation once more through the aorta; in the other the pulmonary blood enters the left heart *via* the pulmonary veins and is recircuited through the lungs by way of the pulmonary artery. Without additional anomalies, this malformation would obviously be incompatible with life. But other anomalies, such as an interauricular septal defect, a patent foramen ovale, an interventricular septal defect, or a patent ductus arteriosus are almost invariably present. In their absence or with their closure, death must follow.

The fact that relative longevity in patients with transposition is associated with interventricular septal defects or multiple shunt pathways was stressed by Hanlon and Blalock, in 1947, in an analysis of 123 proved cases (18). Three years later the same writers described in detail a series of operations aimed at creating further opportunities for mixing of the two circulations (5). These procedures carried with them a high mortality, but so does the anomaly itself. The procedure which was finally adopted as the most efficacious—the creation of an interauricular septal defect plus anastomosis of the proximal portion of the right subclavian artery to the distal portion of the right upper lobe pulmonary artery—has been performed in at least 12 patients, of whom 8 were living and improved at the time of the last report (5). Although improvement is not as dramatic as in children with the tetralogy of Fallot who have been operated upon, it may offer some chance of a more normal life. Moreover, there remains the possibility that other, more effective operations may be devised. Hence the diagnosis of transposition of the great vessels during life has now assumed a very practical significance.

Taussig has described the classical features by which transposition may be recognized during life (34). Further experience may permit refinement of the clinical and roentgenologic criteria which she has enunciated. In the following pages, data on 10 hitherto unpublished cases will be discussed and a few of the case histories will be appended. Nine of these have been proved by autopsy and one by angiocardiography. The literature of the past twenty years has been reviewed and 99 cases with available data have been analyzed. The material from these collected cases (2–5, 7–13, 15–19, 21–25, 27–32, 34–39) has been compared with our own material in an effort to amplify and clarify the criteria for diagnosis.

INCIDENCE

In 1930, Kato (22), in a review of the literature, found 92 cases of transposition of the great vessels and added 5 of his own. A survey of the English literature during the twenty years subsequent to Kato's report has disclosed an additional 94 cases. Thus, at least 191 cases have been reported. In view of the fact that the rarity of this lesion has been stressed (22), it is of interest that cases of transposition comprised about 5 per cent of Maude Abbott's series of 1,000 cases, while tetralogy of Fallot, the most common congenital cyanotic lesion, accounted for about 8 per cent.

SEX

Eight of our 10 proved cases were in

[1] From the Departments of Radiology and Pediatrics, Stanford University School of Medicine, San Francisco, Calif. Accepted for publication in February 1951.

males. In the reported cases for which the sex was stated, the ratio of males to females was 71 to 31.

AGE AT DEATH

The age of our patients at the time of death ranged from eight days to three and a half years. Seven died during the first year, one at two years, and one at three and a half years, the last two following operation. One patient is still alive.

Among 150 reported cases, 34 per cent died by the end of the first month and 86 per cent by the end of the first year. Only 8 per cent of the total group (12 patients) reached the age of five years. A few patients lived to the age of twenty and one reached the age of fifty-six.

PATHOLOGY

Among our 9 autopsy-proved cases of complete transposition were 4 with a patent foramen ovale, 1 with a patent ductus arteriosus, 1 with an interventricular septal defect, 1 with an interventricular septal defect plus a moderate degree of pulmonary stenosis, 1 with a patent foramen ovale and patent ductus arteriosus, and 1 with an interventricular septal defect plus a patent foramen ovale. In all there was enlargement of the right ventricle, and the majority of the patients had left ventricular enlargement as well.

An enlarged right ventricle was one of the common denominators of most of the 162 reported cases for which adequate autopsy data were available. In some cases, the right auricle was enlarged. The left ventricle was frequently enlarged, sometimes massively so (3). Associated shunts, such as patent ductus arteriosus, patent foramen ovale, interauricular septal defect, or interventricular septal defect, were present in all cases except one. Two patients had a right aortic arch (3, 5), and additional anomalies, such as situs inversus, were not uncommon. For an analysis of the relative incidence of shunt pathways in transposition, Hanlon and Blalock's paper may be consulted.

A discussion of the *embryology* of transposition of the great vessels is not within the scope of this paper. The subject has been thoroughly explored in recent years (6, 20, 26).

CLINICAL FINDINGS

The main clinical findings with transposition of the great vessels are cyanosis, dyspnea, clubbing, and heart murmurs.

(*a*) *Cyanosis:* All of our patients were cyanotic. In 1 infant cyanosis was noted on the second day after birth, and in another three months after birth. In all the others it was observed at birth, or within a few hours thereafter. The degree of cyanosis was moderate or marked in all but the patient in whom its onset was late.

In 58 of the collected cases, cyanosis was present at birth, in 26 its onset was delayed, and 1 patient is said to have been acyanotic (12). Of cases with a delayed onset of cyanosis, it developed in hours to days in 6 and after weeks or months in 15; in 5 the interval after birth was not stated. The degree of cyanosis is described as marked in about 55 per cent of the patients, moderate in about 35 per cent, and slight in about 10 per cent. In a few instances cyanosis was present at birth, disappeared for a short period, and subsequently reappeared.

(*b*) *Clubbing:* Definite clubbing of the fingers was present in 5 of our patients, in 1 of whom it was marked, in 1 moderate, and in 3 of slight degree. Among the collected cases clubbing was mentioned as being present in 15 patients, of whom all except one were at least a year of age. Obviously, a large number of deaths occurred before there was time for clubbing to develop.

(*c*) *Dyspnea:* Dyspnea at rest was present in 3 of our patients, in 2 of whom it appeared somewhat late. Among the collected cases, dyspnea was a relatively common finding.

(*d*) *Heart Size:* The heart was enlarged to percussion in 6 of our series. Among the collected cases, the heart was said to be enlarged to percussion in slightly less than a third.

(*e*) *Heart Murmurs:* Murmurs were present in 6 of our cases. Four of the pa-

tients had no murmurs throughout their lives, and in 1 there was no murmur at birth but a harsh systolic murmur developed in the second left interspace at two weeks of age. The murmurs were systolic and were usually heard best to the left of the sternum in the second to fourth interspaces.

Among the 77 collected cases in which the presence or absence of murmurs was recorded, there were 23 with no murmurs. Two were said to have had systolic and diastolic murmurs and the remainder systolic murmurs alone. These were usually heard over the entire precordium, the point of maximum intensity varying considerably. Many were described as loudest to the left of the sternum, or presternally in the region of the third or fourth intercostal space; others were loudest at the apex, and still others at the base. No definite correlation could be established between the type of murmur and the associated findings at autopsy in the reported cases. Thus, while one patient with transposition, a ventricular septal defect, a patent foramen ovale, and a patent ductus had "a systolic and a soft diastolic murmur at the apex" (22), another patient with identical lesions had no murmurs at all (8). It is not surprising, however, that different observers under varying conditions have reported such dissimilar findings.

A review of the literature, then, supports Taussig's statement that "murmurs are of no significance" (35) in establishing the diagnosis, although one of us (A. P.) feels that, with precise auscultation, their value in differential diagnosis is appreciable. Murmurs are of importance in drawing attention to the presence of an organic heart defect, and occasionally in giving information about the associated malformations.

(*f*) *The lungs* were clear in all of our patients except one, in whom râles were heard with the development of congestive heart failure. This was also true of the majority of the collected cases, pulmonary findings being rare except terminally.

(*g*) *The liver* was palpated below the costal margin in 2 of our patients. In about a quarter of the collected cases, the liver was considered enlarged, and in a few instances the spleen as well.

(*h*) *Other reported clinical manifestations* include significant developmental retardation, difficulty in feeding, acute attacks of cyanosis and severe dyspnea of short duration, episodes of loss of consciousness, convulsions, and hemiplegia. It is of interest that none of our patients had acute attacks of cyanosis.

LABORATORY FINDINGS

(*a*) *Red Blood Cell Count and Hemoglobin:* The red blood cell count varied between 3.5 million, in infants, and 11 million per cubic millimeter in our older patients, with an average of about 7 million; the hemoglobin varied betweeen 15 and 26.7 gm., with an average of 19 gm.

Among the 33 collected cases in which the red blood cell count was stated, it ranged between 3.5 million and 11.8 million with an average of 7.8 million. The hemoglobin in 17 of the collected cases varied between 12.4 and 28 gm., averaging 20 gm.

The level of the hemoglobin and red cell count are significant only in that they tend to be high in many patients with transposition and reflect the degree of arterial oxygen unsaturation. About 10 to 20 per cent of the patients have a normal red blood count, which after the first few months of life indicates a relative anemia.

(*b*) *Electrocardiograms:* Among 7 patients on whom electrocardiograms were obtained, there was right axis deviation in 5 and no axis deviation in 2. The P-waves were peaked, notched, or high in 3 of the cases. In 1 patient with no axis deviation, the main deflection of the QRS was downwards in all leads,[2] while in the other the QRS complexes were diphasic and of low voltage. The PR interval was normal in all cases, as was the time of the QRS complex.

[2] These findings are thought to be associated with physical rotation of the heart in right ventricular hypertrophy so that the apex is directed back and up. (Levinthal, J.: Electrocardiograms in Which the Main Deflection of the QRS Complex is Down in All Three Standard Leads. Am. J. Dis. Child. In press).

Electrocardiograms were obtained in 28 of the collected cases. In 23 of these, there was right axis deviation; in 1, left axis deviation (3); in 2, no axis deviation (3, 35). A-V dissociation was present in 1 patient (21), and incomplete bundle branch block in another (5). In 6 cases the P-waves were tall or peaked.

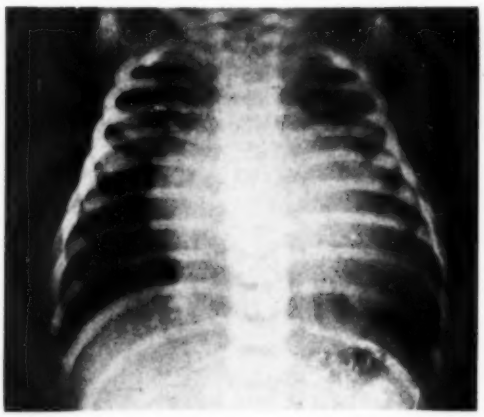

Fig. 1. Case I. Complete transposition of the great vessels. The heart is massively enlarged; pulmonary vessels prominent; aortic knob not visible.

ROENTGEN EXAMINATION

The Conventional Examination

(1) *Postero-Anterior View.* (a) Heart Size: In all our patients with an adequate examination, the heart was definitely enlarged (Fig. 1). The cardiothoracic ratio varied between 0.60 and 0.70 with an average of 0.66. In 1 patient who was ex-

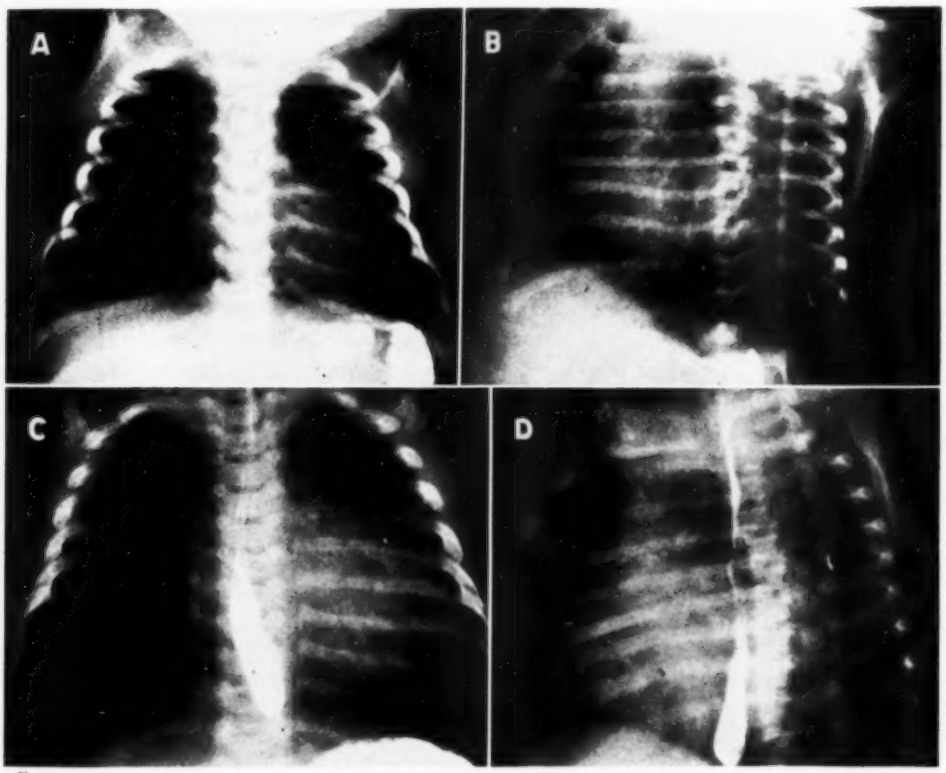

Fig. 2. Case II. Complete transposition of the great vessels, illustrating rapid increase in cardiac size. A. Postero-anterior film at the age of eight days. The heart size is normal. B. Left anterior oblique film at the age of eight days. Note the widening of the great vessel shadow. The diagnosis of transposition was suggested on the basis of this initial examination. C. Postero-anterior film at the age of two and a half months. Marked enlargement has occurred. The mediastinal shadow is narrow. D. Left anterior oblique view at the age of two and a half months. There is widening of the great vessel shadow. The anterior position of the aorta is suggested.

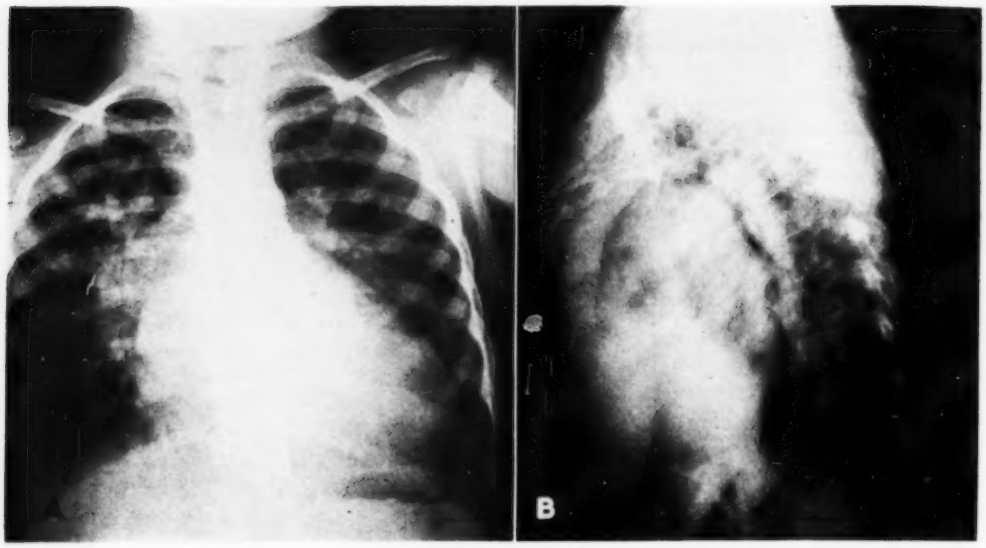

Fig. 3. Case III. Complete transposition of the great vessels, illustrating marked engorgement of the pulmonary vessels.

A. Postero-anterior film. The heart is greatly enlarged and the pulmonary vessels are prominent. The mediastinal shadow is narrow. B. Angiocardiogram in the left lateral projection at about four seconds. The right auricle and right ventricle are opacified, and the aorta is seen arising from the right ventricle in a markedly anterior position. The pulmonary vessels and left auricle are partially opacified, probably through a patent ductus arteriosus and an interauricular septal defect.

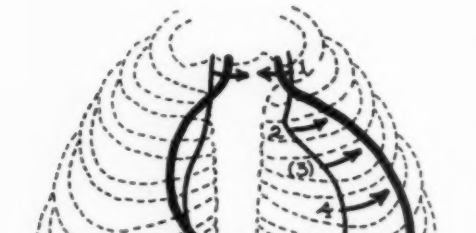

Fig. 4. The outermost tracing from a "typical" case of complete transposition of the great vessels is superimposed upon the cardiovascular silhouette of a normal infant heart. Of the 4 numbered segments along the left cardiovascular border: (1) the aortic or mediastinal segment is usually significantly flattened in transposition, and the aortic knob is not seen; (2) the pulmonary artery segment is frequently obscured by the marked ventricular enlargement, although a gentle concavity may be observed; (3) the middle cardiac segment bulges in a cephalad and lateral direction; (4) the lower left ventricular segment projects laterally with the apex minimally elevated.

amined at the age of eight days, the heart was small. After an interval of two months, however, marked cardiac enlargement was evident, the contrast between the two examinations being striking (Fig. 2). We have observed identical changes in a group of cases which are not yet proved.

(b) The Vascular Shadows: The central pulmonary vessels were obscured by the enlarged heart in 3 patients. In 1, the central vessels were relatively small; autopsy disclosed pulmonic stenosis in this case. In 3 other patients in whom they were easily seen, these vessels were markedly enlarged. In all patients except the one with pulmonary stenosis, the peripheral vessels were engorged (Fig. 3).

(c) The Superior Mediastinum and the Aortic Knob: The superior mediastinum was narrow in 7 patients (Figs. 1–3) and normal in 2. On review of the roentgenograms, it was of interest that the aortic knob could not be identified except in 1 patient, in whom it was small.

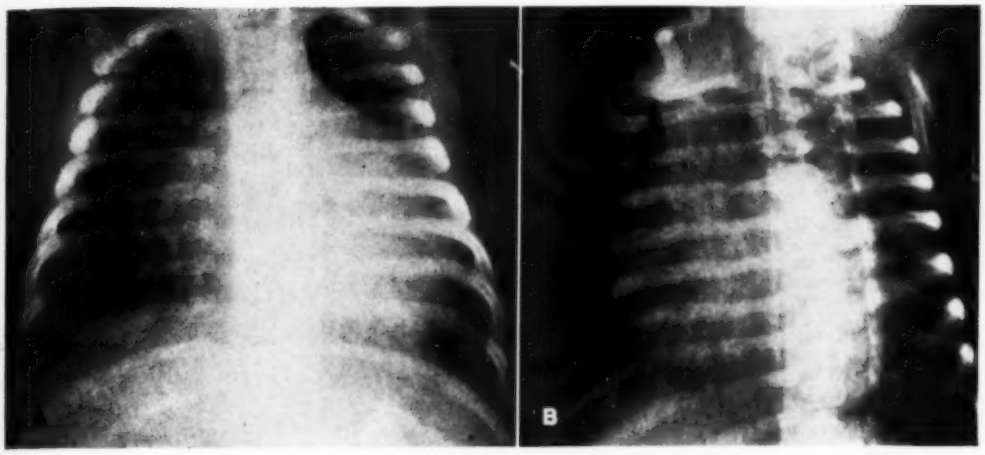

Fig. 5. Case IV. Complete transposition of the great vessels.
A. Postero-anterior view. The heart is enlarged, with marked prominence of the left mid cardiac border. The mediastinum is narrow. The pulmonary vessels are engorged. B. Left anterior oblique view. The great vessel shadow has widened. Both left and right ventricular enlargement are present.

(d) The Apex: Although the apex of the heart was slightly elevated in most instances, it was appreciably closer to the diaphragm than in the tetralogy of Fallot. In the left anterior oblique view the apex was definitely elevated in 2 of our patients, while in the others it was relatively low.

(e) The Left Heart Border: In most of the patients, the left mid cardiac border was convex in appearance, bulging in a cephalad and lateral direction (Figs. 4 and 5). In 4 cases a slight concavity was present in the region of the pulmonary artery.

(*2*) *Left Anterior Oblique View:* In the left anterior oblique view, widening of the great vessel shadow was noted roentgenographically in the 5 patients on whom adequate studies were obtained (Figs. 2 and 5). This observation was not made as consistently on fluoroscopic examination. In all cases it was felt that there was considerable enlargement of both ventricles. The root of the aorta was anteriorly placed.

(*3*) *Right Anterior Oblique View:* The presence of marked enlargement of the right ventricle was confirmed by the anterior bulge of the cardiac silhouette in the right anterior oblique view (Fig. 6B). Significant left auricular enlargement was not observed.

(*4*) *Lateral View:* The lateral view revealed encroachment upon the retrosternal space by the enlarged right ventricle (Fig. 6D), and suggested the forward position of the aortic root.

Radiological examination was performed in 56 of the collected cases. The heart size was stated in 37: in 33 it was large and in 4 within the limits of normal. The mediastinum was described in 32 patients. In 16 of these it was narrow in the frontal projection, and widened in the left anterior oblique view in 8. In 14 cases the mediastinum was described as normal, although in 2 of these there was no aortic knob visible, and in 2 there appeared to be widening of the great vessel shadow in the left oblique view. In 2 patients the mediastinum was wider than normal, probably because of the persistence of a large normal thymus. The lung fields were considered engorged in 25 patients and clear in 1.

In 18 of the case reports in the literature, roentgenograms were reproduced. Twelve of these showed the typical configuration of transposition; 1 was consistent with transposition except for slight right mediastinal widening, probably due to prominence of the vena cava, and 5 were atypical. Among these 5, the heart size was either normal or slightly increased in 3 patients,

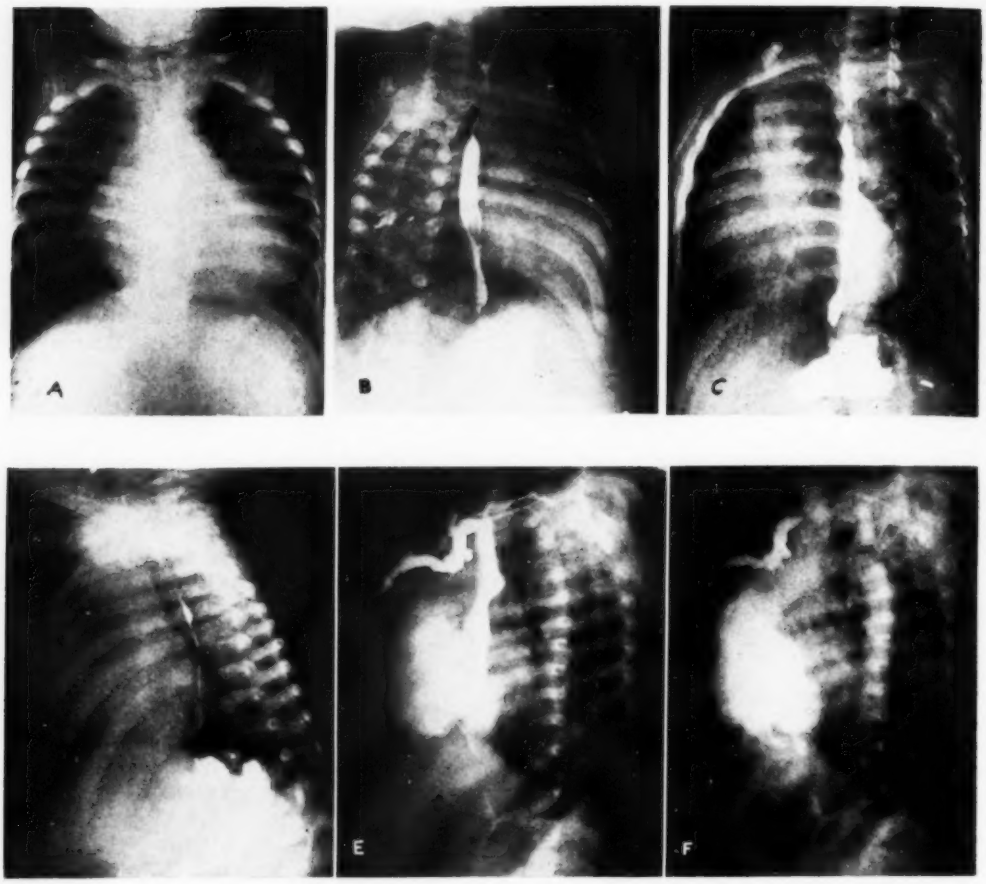

Fig. 6. Case V. Complete transposition of the great vessels.
A. Postero-anterior view. The heart is enlarged. The mediastinal shadow is normal. The pulmonary vessels are prominent. B. Right anterior oblique view. The right ventricular border projects anteriorly, indicating right ventricular enlargement. C. Left anterior oblique view. The great vessel shadow is wide by comparison with the frontal projection. The cardiac contour projects both anteriorly and posteriorly, indicating right and left ventricular enlargement. The apex is elevated. D. Left lateral projection. The enlarged right ventricle fills the retrosternal space. E. Angiocardiogram (2 seconds). The inferior vena cava, right auricle, and right ventricle are opacified. F. Angiocardiogram (4 seconds). The aorta is clearly delineated arising from the right ventricle in an anterior position. The pulmonary artery is not opacified.

all of whom were at least five years of age (2, 7, 9). In 1 case, pulmonary stenosis was present (24). In another there was a bulge at the usual site of the main pulmonary artery, which was shown angiocardiographically to represent the ascending limb of the transposed aorta (16). Castellanos has recently described similar angiocardiographic findings in a group of cases (10).

Angiocardiography

In 2 of our patients, angiocardiograms were obtained in a right posterior oblique projection (Figs. 6 and 7), and in 1 patient in the lateral projection (3). The opaque medium was injected into the antecubital vein, with sequential opacification of the superior vena cava, the right auricle, the right ventricle, and a far anteriorly placed aorta. The pulmonary artery was not opacified during this phase, reflecting the absence of direct communication between the artery and right ventricle. The anterior position of the aorta was sufficiently

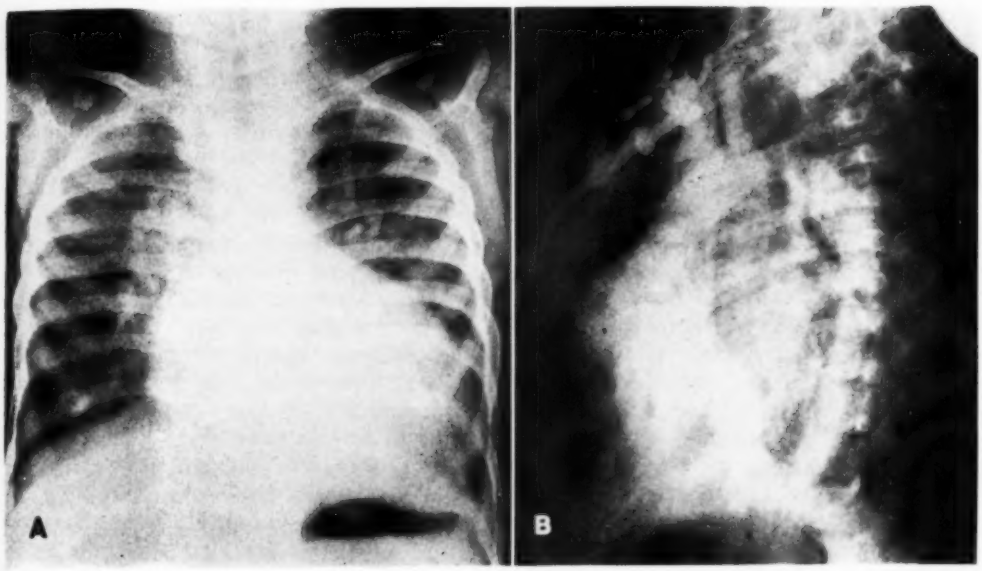

Fig. 7. Case VI. Complete transposition of the great vessels.
A. Postero-anterior view. Marked cardiac enlargement is present, with prominence of the left mid cardiac segment. The great vessel shadow is narrow, and no aortic knob is visible. The pulmonary vessels are engorged.
B. Angiocardiogram. The aorta arises anteriorly from the large right ventricle, and no opacification of the pulmonary artery is noted.

characteristic to prevent confusion with simple overriding of the aorta. In addition, a large right ventricle was visualized.

Angiocardiograms have been reproduced in the literature with the patient in the postero-anterior, left anterior oblique, and lateral positions (5, 9, 10, 16, 23). In the frontal projection, the aorta arose from the conus portion of the right ventricle. In the left anterior oblique and in the lateral projections, the anterior position of the aorta was clearly demonstrated.

CARDIAC CATHETERIZATION

While we have had no experience with cardiac catheterization in this anomaly, it seems doubtful that it would be of differential diagnostic importance. Campbell, Bing *et al.* reported studies on 2 patients with transposition of the great vessels (8). Because of the difference in oxygen saturation of the blood in the vena cava and in the heart chambers, they were able to predict the presence of septal defects. In one of the patients the aorta was catheterized directly from the right ventricle, but since this can also be done in the tetralogy of Fallot, it is not diagnostic. In patients with transposition of the great vessels who are being considered for operation, catheterization is important in ruling out the presence of a large interauricular septal defect. One cannot, however, make an unequivocal diagnosis of complete transposition by this method.

DISCUSSION

Clinical Findings. The most frequent findings in the recorded cases were early severe cyanosis, with associated dyspnea, clubbing, and polycythemia; cardiac enlargement; variable murmurs, usually systolic and more often than not heard along the mid and lower left sternal margin; and right axis deviation.

Study of our group of cases allows the following additional observations:

(1) The cyanosis is usually uniform in distribution; the time of onset and degree depend on the accompanying shunts.

(2) Acute cyanotic, dyspneic, or asphyxial spells rarely occur.

(3) The presence or absence, intensity, and transmission of the murmur (which was always systolic in our series) depend on the shunts and the state of compensation at the time of auscultation.

(4) The clinical course may afford clues to the type of shunts present.

(5) Arm and leg pulses are normal. (The blood pressure was also normal in the few patients on whom pressure readings were obtained.)

One of us (A.P.) feels that the clinical pattern outlined above may be highly suggestive, though not entirely diagnostic.

Roentgen Findings: The roentgen appearance of transposition of the great vessels in a patient with cyanosis from birth is often characteristic enough to establish the exact diagnosis. The roentgenographic evidence must be integrated with such clinical findings as the presence of pronounced early cyanosis, of a murmur thought to be due to organic disease, and of an electrocardiogram showing marked right axis deviation, which are important in excluding acyanotic congenital heart disease and acquired heart disease.

With clinical evidence of a congenital cyanotic cardiac anomaly, a proper evaluation of the roentgenologic data is feasible. For an adequate examination, fluoroscopy and roentgenograms in the four standard projections (postero-anterior, right and left anterior oblique, and left lateral) are essential. At fluoroscopy, the character of the pulmonary vessels, the size of the mediastinal shadow in the postero-anterior and left anterior oblique projections, the over-all heart size, and the individual chamber size may be assessed. The degree of obliquity at which the roentgenograms are taken should also be determined at fluoroscopy. In general, the right anterior oblique view is taken at 45 degrees and the left anterior oblique view at 60 degrees. Erect posture is essential to avoid distortion of the cardiac contours. With correct positioning, short exposure time, and care that the roentgenograms are obtained during inspiration, an adequate roentgen examination will be secured. Roentgenograms are important in providing permanent records, permitting critical evaluation of fluoroscopic findings. The most important of the positive roentgenologic findings in transposition are as follows:

(*a*) *A Large Heart* (Figs. 1–7): The increased size of the heart is the result of both right and left ventricular enlargement. Marked enlargement may not be apparent before the age of about two months. In those cases in which cardiac size and shape are known from roentgenologic examination performed shortly after birth, the subsequent change in size and contour is characteristic (Fig. 2).

(*b*) *A Cephalolateral Bulge in the Left Mid Cardiac Border:* The point of maximum bulge is designated as Segment 3 on Figure 4. This segment is almost invariably convex, although a slight concavity may be present in the region of the pulmonary artery segment (Segment 2, Fig. 4).

(*c*) *A Narrow Mediastinal Shadow in the Frontal Projection* (Figs. 1, 2, 3, 5, 7): At times the mediastinal shadow may be normal or even wider than normal. This is usually due to persistence of the thymus or to fullness of the superior vena cava. In such cases the lack of a clearly delineated aortic knob may be a significant feature.[3] This finding is probably due to lessened obliquity of the course of the aorta, since the root of the aorta arises anteriorly and to the left, and the course of the arch is more directly anteroposterior.

(*d*) *Widening of the Great Vessel Shadow in the Left Anterior Oblique Projection:* Taussig, in her classical description of the clinical features in transposition, emphasized and explained this finding (34). In the frontal projection the transposed aorta and pulmonary artery are superimposed, producing a narrow silhouette; in the left anterior oblique projection, however, they lie side by side and hence cast a widened shadow. In those cases in which this ob-

[3] Although the aortic knob is relatively less distinct in infancy and childhood than in adult life, in the commoner cyanotic lesions—the tetralogy of Fallot, tricuspid atresia, truncus arteriosus—the volume of blood carried by the aorta is significantly elevated, and hence the knob is usually distinguishable.

servation is noted with certainty, it is an important diagnostic aid.

(*e*) *Prominence of the Pulmonary Arterial Branches:* In contrast to many of the cyanotic lesions, transposition of the great vessels is characterized by pulmonary vascular engorgement. This is true not only of the central vessels, but also of the peripheral arterial branches. Frequently, however, the central vessels are obscured by the enlarged heart. Active pulsation of the pulmonary vessels may often be observed fluoroscopically.

(*f*) *Right and Left Ventricular Enlargement:* In the left anterior oblique view, the right ventricular border protrudes toward the anterior chest wall and the left ventricular border extends more posteriorly than normal (Fig. 6).

In those cases in which the routine clinical and roentgen findings are equivocal, angiocardiography may be relied upon to establish the diagnosis. In a deep right posterior oblique or lateral projection, the markedly anterior location of the opacified ascending aorta is distinctive. This appearance is found only in the presence of a transposed aorta.

It should be emphasized that these roentgen findings are applicable only within the first few years of life. We have had no experience with older children. Goodwin, *et al.* (16), Campbell and Hills (9), and Brown (7) have described cases, 2 proved by angiocardiography and 1 by autopsy, in which gross cardiac enlargement was not a roentgenologic feature. In addition, there was in 1 case a bulge at the usual site of the pulmonary artery segment of the left heart border, the appearance suggesting an Eisenmenger complex. These patients were five, nine, and twenty years old, respectively, and the possibility must be considered that in older age groups, the criteria set forth above may not be sufficient to establish the diagnosis. More recently, Castellanos *et al.* have presented the angiocardiographic findings in 7 cases of transposition of the great vessels, 3 of which were autopsy-proved (10). It was their feeling that "the cardiac outline has no value whatsoever in the diagnosis of transposition." Since no plain films were presented, their cases could not be analyzed. From the angiograms, however, it seemed possible that their Cases I, II, and III might fit some of the usual criteria for diagnosis, although the other cases appeared atypical. The age was not stated in any instance.

Differential Diagnosis: In the differential diagnosis of transposition of the great vessels the clinical and radiologic data must be carefully evaluated.

In *tricuspid atresia*, left axis deviation is usually but not invariably present (1). Since cases of transposition of the great vessels and other cyanotic congenital cardiac anomalies have been reported with left axis deviation (3, 14, 33), this finding is not pathognomonic of tricuspid atresia in a cyanotic congenital cardiac. Unipolar lead electrocardiography is valuable in congenital heart disease, in order to obtain accurate information about the presence of ventricular hypertrophy (33). Roentgen examination in tricuspid atresia shows the lung fields clear; the heart is usually not greatly enlarged, and there is a concavity of the pulmonary artery segment. In the left anterior oblique view, there may be some straightening of the anterior heart border, indicating a hypoplastic right ventricle (although in our experience this has not been a reliable sign). In rare cases of tricuspid atresia, the roentgenologic appearance of the heart early in life may suggest transposition (1). In such cases, angiocardiography is distinctive.

In the *tetralogy of Fallot*, the lung fields are either normal or relatively avascular, and the heart is rarely enlarged. The cardiothoracic ratio in our cases of tetralogy of Fallot was under 0.5 in all but about 10 per cent of the cases. In none did it exceed 0.6. In addition, there is marked concavity of the pulmonary artery segment of the left cardiac border, an elevated apex, and evidence of right ventricular enlargement with absence of left ventricular enlargement in the oblique views.

In *truncus arteriosus*, the aortic knob is

prominent. The heart may be enlarged, and the pulmonary artery segment usually presents a marked concavity. The lung fields are relatively clear, although multiple punctate densities, representing anastomotic vessels, may produce a fine, mottled appearance. The hilar "commas" may be absent. In our small experience with this anomaly, the marked enlargement described in truncus arteriosus has not been a consistent finding.

In the *Eisenmenger complex*, the pulmonary vessels are prominent, but the heart is usually normal in size, or only slightly enlarged. The pulmonary artery segment of the left upper cardiac border is likely to be prominent, and the mediastinal shadow is not significantly narrowed. The onset of cyanosis is usually late.

The *Taussig-Bing syndrome* (transposition of the aorta with levoposition of the pulmonary artery) presents a roentgenologic appearance similar to that of the Eisenmenger complex. Cyanosis, however, is early in onset and of severe degree (30). In the case described by Taussig and Bing, heart catheterization was of help in excluding the Eisenmenger complex, since the pulmonary artery oxygen saturation was higher than the right ventricular oxygen saturation (30). Catheterization will not distinguish between the Taussig-Bing syndrome and complete transposition of the great vessels, but the combination of an angiocardiographically demonstrated transposed aorta together with a roentgenographic appearance resembling the Eisenmenger complex may help to establish the diagnosis.

Finally, it should be emphasized that the cardiac configuration in complete transposition of the great vessels is not pathognomonic. A similar appearance may be seen in cases of coarctation of the aorta of the infantile type, interventricular septal defect, and various types of acquired heart disease. The diagnostic value of the roentgen appearance of the heart in transposition lies in the fact that it is usually distinctively different from the appearance in the other common cyanotic congenital cardiac malformations. As an obvious corollary, clinical data supporting the presence of a congenital heart defect producing significant cyanosis from infancy must be available before the criteria for diagnosis described above can be applied.

CASE HISTORIES

CASE II (Courtesy of Dr. Mason Abramson): R. H., a male infant, born Aug. 26, 1948, was normal at birth but became cyanotic on the second day. Thereafter he became ashen when taken out of oxygen. The heart was found to be enlarged and a diagnosis of congenital cardiac disease was made on the second day. No cyanotic or dyspneic spells occurred.

Physical Examination: On the sixth day physical examination showed marked generalized symmetrical cyanosis. Enlargement of the heart was present, slight until the age of two and a half months. A murmur was usually heard, varying in intensity from very soft at six days to harsh at two and a half months. It was maximal between the apex and the left sternal margin and was transmitted upward, especially to the right. The liver edge was 1.0 cm. below the costal margin.

Laboratory Findings: The red blood cell count was 6.3 million, and the hemoglobin 17 gm.

Electrocardiogram: Right axis deviation was present and the T-waves were abnormal (T_1 and T_2 diphasic, and T_3 low).

Roentgen Examination (Fig. 2): The initial roentgen examination was obtained at the age of eight days, at which time the heart was normal in size, with minimal prominence of the left mid cardiac border. The great vessel shadow was narrow in the postero-anterior projection and widened in the left anterior oblique projection. Subsequent examination at the age of two and a half months revealed marked cardiac enlargement, both right and left ventricular, with bulging of the left mid cardiac border. Widening of the great vessel shadow as the patient was turned from postero-anterior to the left anterior oblique projection was noted. The pulmonary vessels were engorged. The roentgen diagnosis was complete transposition of the great vessels.

Clinical Diagnosis: Complete transposition of the great vessels.

Course: The patient was followed at home without significant improvement. He died suddenly at the age of six months.

Autopsy: Examination of the heart and great vessels disclosed complete transposition of the great vessels. There was marked enlargement with hypertrophy of the right ventricle. The foramen ovale was patent. The interventricular septum was intact, and the ductus arteriosus was closed.

CASE III: C. M., a 13-month-old female child, was first seen in August 1948 because of cyanosis.

The color had been normal at birth, but cyanosis, increased by exertion and respiratory infection, appeared early. A harsh systolic murmur was heard at six weeks. Only one true blue spell ever occurred, and that was induced by trauma. Function had always been reduced, and the child tired easily but never squatted to rest.

Physical examination showed a mild, generalized cyanosis with minimal clubbing and some prominence of superficial veins. The chest was barrel-shaped and asymmetrical, with precordial fullness. A harsh systolic murmur, maximal in the third and fourth left interspaces between the sternal margin and the apex, and widely transmitted in all directions throughout the chest, neck vessels, and upper abdomen, was always heard. P_2 was loud.

Laboratory Findings: The red blood cell count ranged between 6 and 7 million, and the hemoglobin between 17 and 20 gm.

Electrocardiogram: Marked right axis deviation was present. P waves, especially in lead 2, had always been tall. Recently P waves in leads 2 and 3 had become large, blunt, and notched.

Roentgen Examination (Fig. 3): There was marked cardiac enlargement, with bulging of the left mid cardiac border and slight concavity of the pulmonary artery segment. In the oblique views, both ventricles appeared enlarged. The great vessel shadow was narrow in the frontal projection and widened in the left anterior oblique projection. The aortic knob could not be delineated. Marked prominence of the pulmonary vessels was present. The roentgen diagnosis was complete transposition of the great vessels.

Clinical Diagnosis: Complete transposition of the great vessels, with patent fetal passages; probable septal defect.

Course: As there has been relatively little change in the degree of cyanosis, clubbing, or polycythemia, so there has been surprisingly little change in cardiac size, shape, and sounds throughout the two years of observation of this patient. There has been throughout her life a tendency to pulmonary respiratory diseases.

Angiocardiography, performed Aug. 1, 1950, demonstrated the aorta arising from the right ventricle anteriorly and confirmed the diagnosis of transposition of the great vessels. The patient is alive and her condition unchanged.

CASE IV: M. M., 3-month-old male baby, was brought to the Cardiac Clinic. He had been feeble and had cyanosis which was intractable to oxygen from birth. A diagnosis of congenital cardiac defect was made at the age of three days. No cyanotic, dyspneic spells had ever occurred, though the child's color deepened considerably with crying.

Physical examination showed a marked generalized symmetrical cyanosis with dilated, tortuous veins of scalp and fingers. The heart was enlarged both to the right and left. There was a well heard, harsh systolic murmur, maximal along the mid and lower left sternal border, widely noted throughout the chest. Femoral and radial pulsations were normal.

Laboratory Findings: The red blood cell count was 5.4 million and the hemoglobin 17 gm.

Electrocardiogram: Right axis deviation was present, with P_1, P_2, and P_3 peaked. There was a tall R-wave in V_1, decreasing across the chest to V_6.

Roentgen Examination (Fig. 5): The heart was greatly enlarged, with a marked bulge in the left mid cardiac border. In the oblique views, there was evidence of right and left ventricular enlargement. The great vessel shadow, narrow in the frontal projection, widened in the left anterior oblique view. The pulmonary vessels were prominent. The roentgen diagnosis was complete transposition of the great vessels.

Clinical Diagnosis: Complete transposition of the great vessels.

Course: Cyanosis remained unchanged, and the patient died suddenly at home nine days after he was first seen.

Autopsy: Examination disclosed complete transposition of the great vessels. There was dilatation and hypertrophy of the right ventricle. The right and left ventricular walls were of equal thickness. The foramen ovale was patent. The ductus arteriosus was closed.

CASE V: S. B., a 1-year-old male, was first seen in July 1948 because of persistent cyanosis. At the age of two weeks he had an episode of cyanosis, respiratory distress, and collapse; marked cardiac enlargement was found at five weeks. There had been no true cyanotic asphyxial spells.

Physical examination showed considerable cyanosis and clubbing. The heart was enlarged. There was an inconstant murmur over the lower half of the heart.

Laboratory Findings: The red blood cell count was 7.6 million and the hemoglobin 19.5 gm.

Electrocardiogram: Right axis deviation and abnormally tall and peaked P and T waves were present.

Course: Cyanosis persisted. The patient entered the hospital at the age of twenty-two months with a big liver and spleen, gallop rhythm, and striking venous distention. No murmur could be heard. Oxygen saturation was 29 per cent. After digitalization, a harsh systolic murmur was heard, maximal between the apex and left mid sternal border and transmitted best to the right base. The course was complicated by a severe urinary tract infection.

Roentgen Examination (Fig. 6): The heart was enlarged, with fullness of the left mid cardiac border. In the oblique views, there appeared to be both right and left ventricular enlargement. Although the mediastinum was not narrow in the posteroanterior views, there appeared to be slight but definite widening of the great vessel shadow on the

roentgenograms in the left anterior oblique projection. This was not observed fluoroscopically. The roentgen diagnosis of complete transposition of the great vessels was confirmed by angiocardiography.

Because of the steady deterioration of the boy's condition, an operation was decided upon, but he died as soon as the cardiovascular structures were exposed.

Autopsy: Examination of the heart and great vessels disclosed complete transposition of the great vessels. The right ventricle was enormously enlarged, and its wall was slightly thicker than that of the left ventricle. The foramen ovale was patent and an 8 × 15-mm. defect was present in the membranous portion of the interventricular septum. The ductus arteriosus was closed.

SUMMARY AND CONCLUSIONS

1. The clinical and radiologic features in 10 proved cases of complete transposition of the great vessels have been described.

2. The recent literature on this anomaly has been reviewed.

3. The radiologic features are distinctive among the congenital cardiac malformations of the cyanotic group. In conjunction with the clinical data, they usually permit accurate diagnosis to be made during life.

4. In atypical cases angiocardiography, by demonstrating the transposed aorta, is an invaluable diagnostic aid.

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SUMARIO

El Diagnóstico de la Transposición Total de los Grandes Vasos

En la literatura (en inglés) de los últimos veinte años encontráronse 99 casos de transposición total de los grandes vasos. Los AA. analizan ahora los hallazgos en esos casos, comparándolos con sus propias observaciones en otros 10. Nueve de este último grupo fueron confirmados en la autopsia y 1 por la angiocardiografía, ofreciéndose las historias de 4 de éstos.

Los hallazgos clínicos más frecuentes son: intensa cianosis temprana con la cual se asocian disnea, dedos hipocráticos y policitemia; hipertrofia cardíaca; soplos variables, por lo general sistólicos y oídos más a menudo a lo largo de los bordes medio e inferior izquierdos del esternón; desviación del eje derecho. En sus casos, los AA. observaron que la cianosis suele ser uniforme en su distribución, dependiendo la fecha de su iniciación e intensidad, de las desviaciones concomitantes. Los episodios agudos de cianosis, disnea o asfixia fueron raros.

En los enfermos con cianosis congénita el aspecto roentgenológico es a menudo suficientemente típico para establecer el diagnóstico exacto. Para estudio adecuado, se necesitan la roentgenoscopia y vistas postero-anteriores, oblicuas anteriores de derecha e izquierda y laterales izquierdas. Las características roentgenológicas consisten en: hipertrofia del corazón, con hipertrofia ventricular tanto derecha como izquierda; convexidad cefalolateral del borde mesocardíaco izquierdo; estrecha imagen mediastínica en la proyección frontal; congestión vascular en los pulmones, comprendiendo tanto los vasos centrales cuanto las ramas periféricas de las arterias. En los angiocardiogramas, resulta distintiva la localización decididamente anterior de la oscurecida aorta ascendente, según se observa en una proyección oblicua posterior o lateral derecha.

La configuración cardíaca no es patognomónica en la transposición total de los grandes vasos. El valor diacrítico del aspecto roentgenológico estriba en que suele ser netamente distinto del observado en otras de las corrientes malformaciones congénitas con cianosis. Corolario de rigor es que, antes de aplicar las pautas de diagnóstico aquí ofrecidas, hay que contar con datos clínicos que apoyen la existencia de una deformidad congénita del corazón que produzca cianosis significativa desde la infancia.

Asymptomatic Gastric Mucosal Prolapse[1]

EMANUEL J. LEVIN, M.D.,[2] and BENJAMIN FELSON, M.D.[3]

FOLLOWING THE original description of gastric mucosal prolapse by von Schmieden (13) in 1911, only sporadic reports of this phenomenon were found in the literature until Scott's paper was published in 1946 (14). Since then, numerous articles have appeared in both the radiological and clinical journals (3, 4, 6, 7, 8, 9). Most writers have stressed the occurrence of symptoms in this condition—notably abdominal pain, nausea, vomiting, bloating, heartburn, and hematemesis—and have implied that these symptoms were attributable to the prolapse.

A review of the literature has revealed few statements discounting the importance of gastric mucosal prolapse as a symptom-producing entity. Bockus (2) considered the lesion a rare cause of symptoms, and Alvarez (1), Howard (5), and Sanders (12) attached little or no clinical significance to it. In an earlier communication (4) we stated that we were not certain that gastric prolapse was a clinical entity.

Unquestionably, patients with prolapse of the gastric mucosa often have symptoms, and these have been relieved by various therapeutic measures, including diet, antacids, psychotherapy, and surgery. It has never been established, however, at least to our satisfaction, that the prolapse is actually the cause of these symptoms and not simply an incidental finding. The fact that we occasionally encountered significant degrees of prolapse unassociated with gastro-intestinal complaints increased our uncertainty and led us to undertake the present study to determine the incidence in asymptomatic patients.

METHOD

Gastro-intestinal roentgen studies were made in 100 co-operative adult hospital patients in whom the sole criterion of selection was the complete absence of gastro-intestinal symptoms in recent years.

The upper gastro-intestinal tract of the fasting patient was examined fluoroscopically with the usual barium-water suspension. Spot films of the duodenal bulb were obtained in both the upright and recumbent positions, a minimum of eight exposures being made in each case. No reliance was placed upon the fluoroscopic findings, the presence or absence of prolapse being determined entirely from the films.

The following roentgenographic criteria for the diagnosis of gastric mucosal prolapse were utilized:

1. Concavity of the base of the duodenal bulb.

TABLE I: AGE INCIDENCE OF GASTRIC PROLAPSE

Age	No. of Cases	Prolapse			
		Slight	Moderate	Marked	Total
20–29	20	1 (5%)	0	0	1 (5%)
30–39	30	5 (16.6%)	3 (10%)	1 (3.3%)	9 (30%)
40–49	17	3 (17.6%)	1 (5.8%)	1 (5.8%)	5 (29.4%)
50–59	16	1 (6.2%)	1 (6.2%)	1 (6.2%)	3 (18.7%)
60 and over	17	0	0	0	0
TOTAL	100	10 (10%)	5 (5%)	3 (3%)	18 (18%)*

* Omitting all cases of slight prolapse (see text), 8 (8%).

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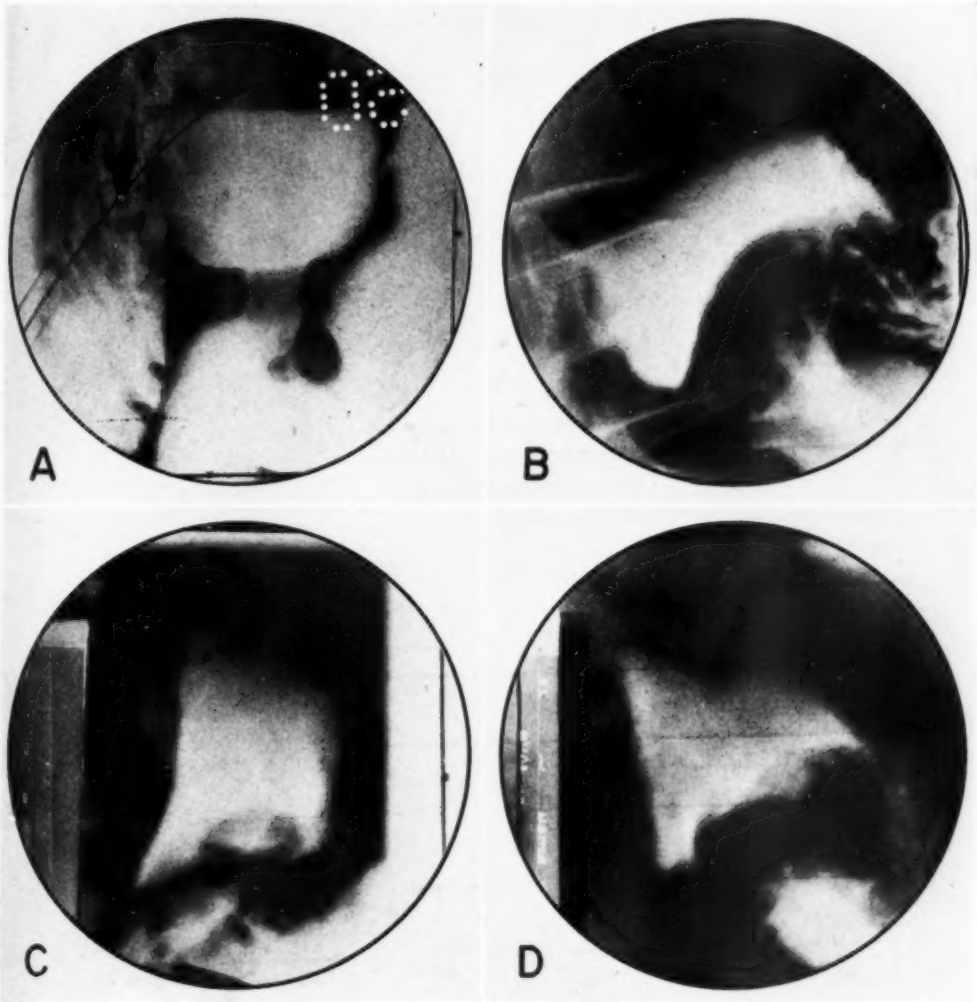


Fig. 1. Spot films of the duodenal bulb in 4 different patients. Note the variation in the appearance of the base of the bulb. Such findings were not attributed to gastric prolapse.

2. Mucosal folds passing from the stomach into the bulb.

3. Inconstant deformity of the base of the bulb caused by the varying degree of the prolapse.

A slight to moderate degree of concavity of the base of the duodenal bulb without evidence of gastric folds traversing the pylorus was not considered to represent gastric prolapse (Fig. 1). Similarly, multiple indentations of slight degree at the base of the bulb were also included in the normal group (Fig. 2). Any case in which an unsuspected lesion was found was, of course, excluded from the series. Since the bulbar deformity of duodenal ulcer may closely simulate that of gastric prolapse, several cases of prolapse in which such a deformity suggested a possible associated healed ulcer were also excluded.

The cases of prolapse were grouped as follows:

Slight Prolapse: Marked concavity of the base of the duodenal bulb and/or definite

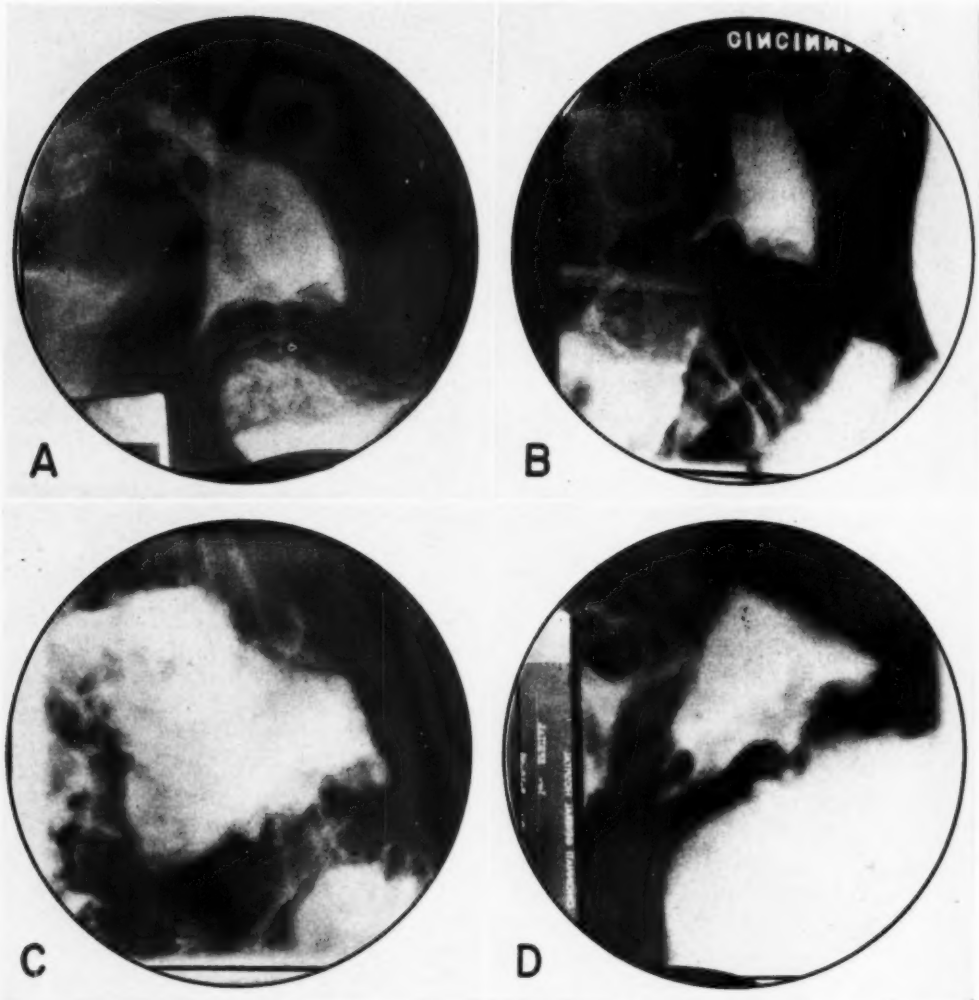


Fig. 2. Irregularity and multiple indentations in the base of the bulb as seen in 4 different patients. These changes were not ascribed to prolapse.

evidence of gastric mucosa projecting into the bulb for a distance of less than 25 per cent of the total area of the bulb (Fig. 3).

Moderate Prolapse: Gastric mucosa occupying from 25 to 50 per cent of the total area of the bulb (Fig. 4).

Marked Prolapse: Gastric mucosa occupying more than 50 per cent of the area of the bulb (Fig. 5).

RESULTS

Of the 100 cases, 82 revealed a normal bulb and 18 showed gastric prolapse. Ten were graded as slight prolapse, 5 as moderate, and 3 as marked.

The age distribution is shown in Table I. It is to be noted that none of the 17 patients over sixty years of age and only 1 of the 20 under the age of thirty showed prolapse. There were 42 females and 58 males in the series, and no significant difference in the sex incidence was noted.

The frequency of gastric prolapse in relation to the major hospital discharge diag-

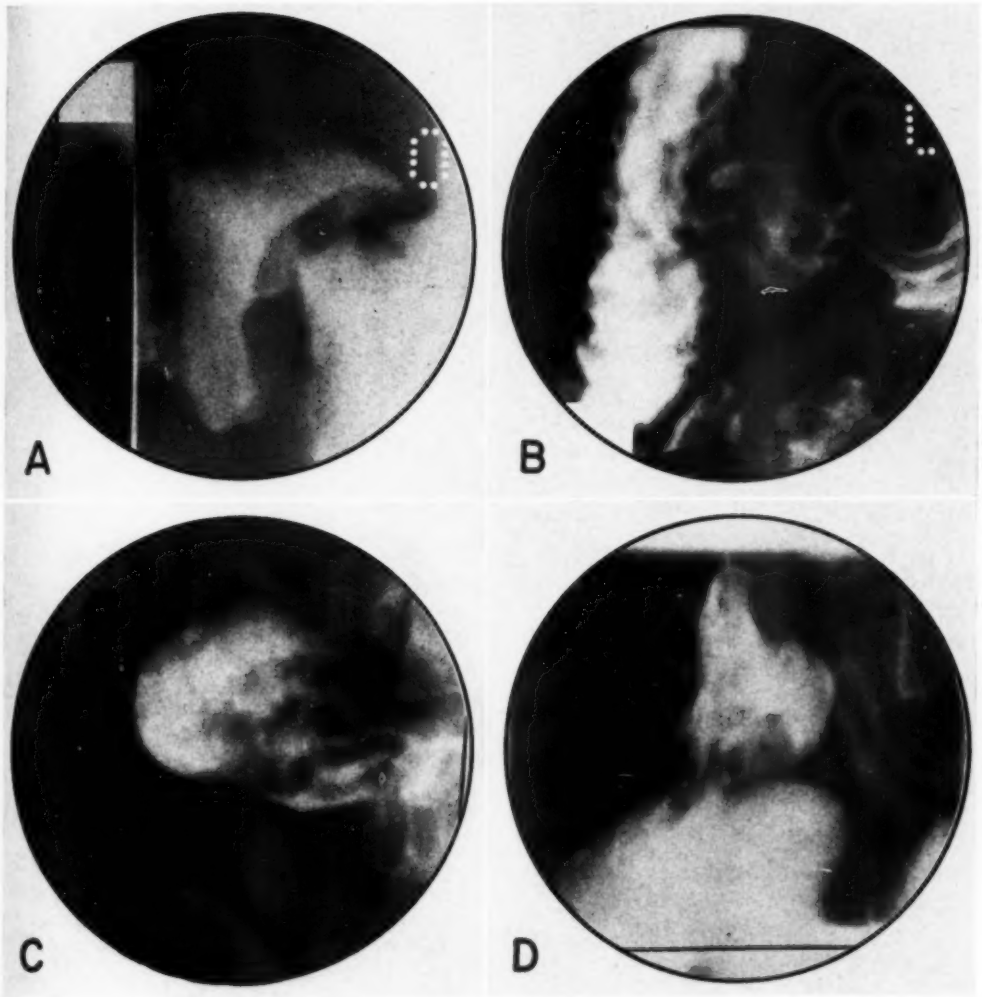


Fig. 3. Four cases showing slight gastric mucosal prolapse.

noses of these patients was studied. Contrary to the point of view expressed by Melamed and Melamed (6), the incidence of prolapse was not increased in cardiac failure. From our study, it seemed apparent that the incidence was not significantly affected by any particular systemic disease.

During the course of the study several additional findings of interest were noted. We were impressed with the frequency of variation in the appearance of the base of the normal bulb. This variation occurred not only in different patients, but also from one moment to the next in the same patient. The base of the bulb appeared rather straight in 22 cases (Fig. 1A), slightly concave in 37 (Fig. 2A), and either moderately concave (Fig. 1B) or irregular (Fig. 2B) in 23. It is quite possible that some of the latter group represented minimal degrees of gastric prolapse, but, because of our uncertainty, we preferred to include them in the normal group. It was apparent that the optimum position for the demonstration of gastric prolapse also varied from case to case. Usually any

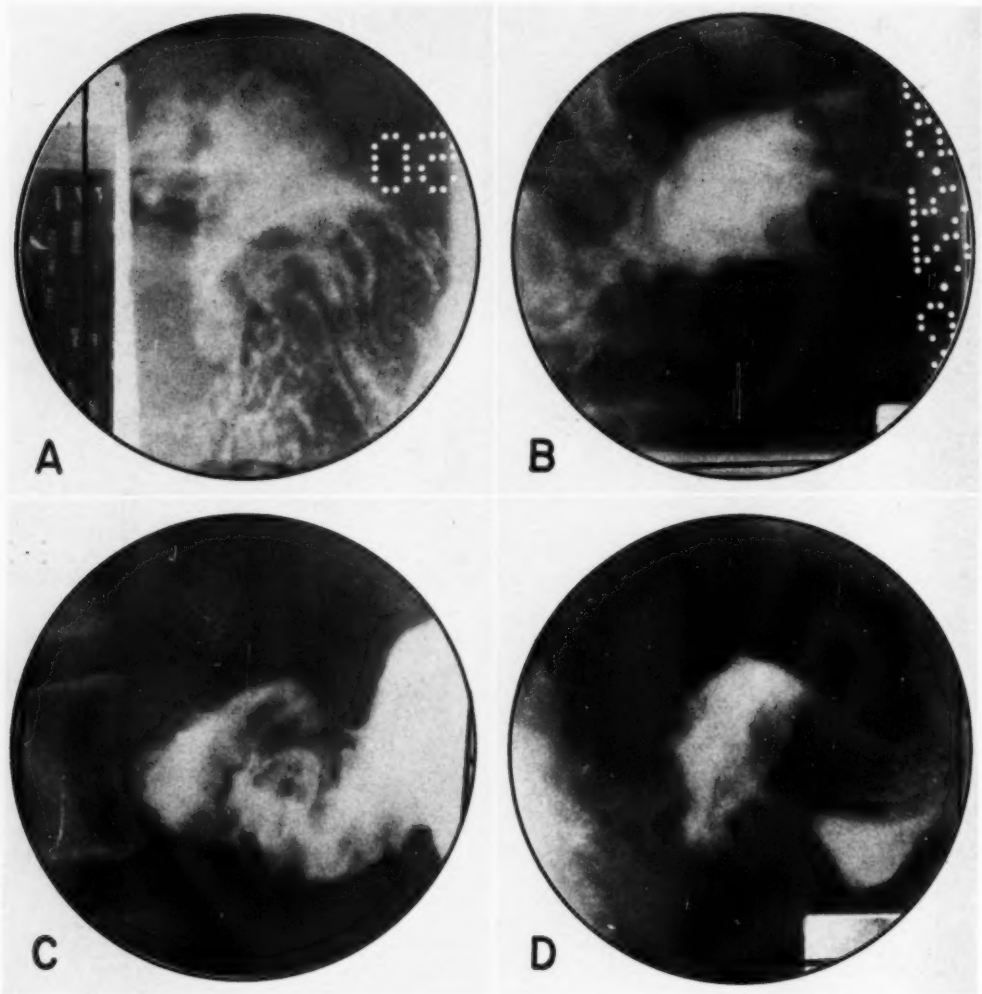


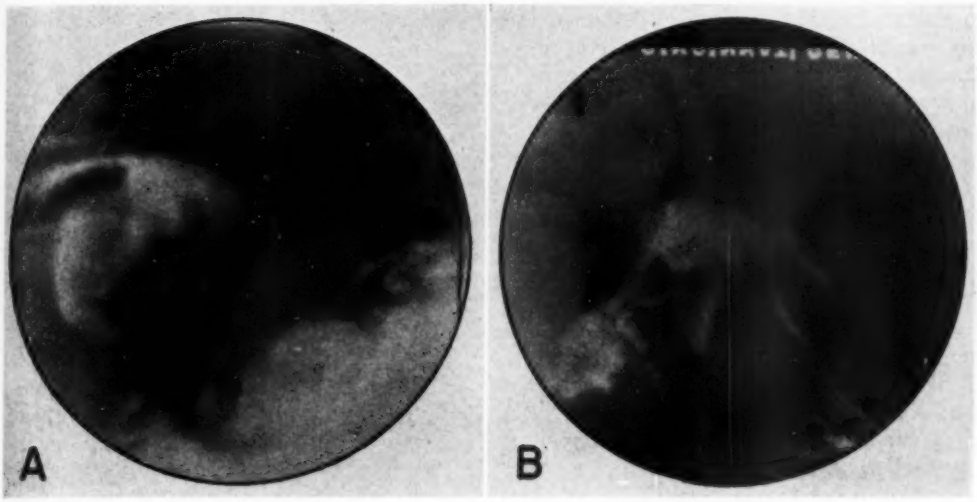
Fig. 4. Four cases of moderate gastric prolapse.

position which afforded a clear and unobstructed view of the bulb was satisfactory, whether the patient was upright or recumbent.

DISCUSSION

The high incidence of gastric mucosal prolapse (18 per cent) in this group of asymptomatic patients came somewhat as a surprise, in view of our earlier experience (4), in which this condition appeared in only 2.8 per cent of 1,257 symptomatic patients. We believe that this apparent increase is due to our greater awareness of the condition, and to the recognition of lesser degrees of prolapse. In a recent unpublished review of 77 cases of acute gastro-intestinal bleeding in which upper gastro-intestinal series were performed without palpation, we encountered gastric prolapse in 19 per cent. Of this number 10 per cent were slight, 5 per cent were moderate, and 4 per cent were marked. These figures check closely with those of the present study.

Our present findings are at variance with



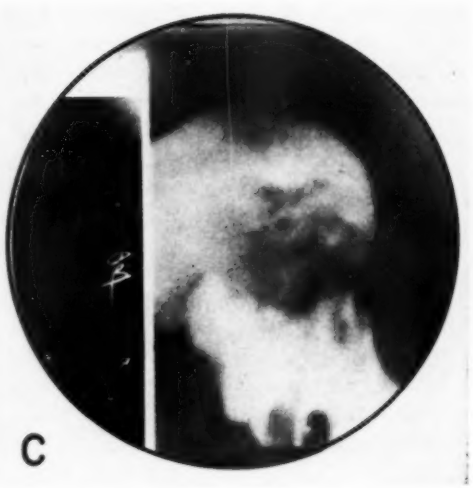


Fig. 5. Three cases of marked gastric prolapse. Unfortunately the full extent of the prolapse is lost in reproduction.

those of Scott (14), who reported an incidence of slightly over 1 per cent in 1,346 symptomatic patients, and did not encounter a single case of prolapse among 200 injured sailors who had no gastric complaints. However, Scott (15) recently stated, "In my experience, small or even moderately large prolapses of the gastric mucosa are rather commonly seen in patients without gastric complaint.... I usually do not consider these as being pathological."

It is possible that our roentgen criteria for gastric prolapse are not as rigid as those of other writers on this subject, and perhaps, as suggested by Schatzki (16), the changes in some of our cases of slight prolapse might be explained by superimposition of the prepyloric segment of the stomach upon the base of the duodenal bulb. However, even if all of the cases of slight prolapse were excluded, we would still be left with an 8 per cent incidence of gastric prolapse in the present series.

From the present study, it is apparent that gastric mucosal prolapse is not uncommon in the absence of gastro-intestinal symptoms. It follows that prolapse may occur as an incidental roentgen finding in patients who have gastro-intestinal complaints arising from some other cause. We do not doubt that it is possible, in an occasional case, for gastric prolapse to cause any or all of the symptoms attributed to it. It is not difficult to conceive that the herniated gastric mucosa, subjected to repeated trauma by the pylorus, might cause gastritis, hemorrhage, or obstruction. Indeed, such complications have been occasionally reported (8, 10). It appears, therefore, that gastric mucosal prolapse cannot be casually dismissed as a *completely* inconsequential finding. It is our belief,

however, that the clinical importance of this condition has been grossly over-emphasized. We feel that it is seldom productive of symptoms and that undue significance should not be attached to its presence.

SUMMARY AND CONCLUSIONS

1. Upper gastro-intestinal roentgen studies were performed in 100 patients who had no gastro-intestinal symptoms.

2. Gastric mucosal prolapse was encountered in 18 cases. The prolapse was slight in 10, moderate in 5, and marked in 3.

3. No significant increase in frequency of prolapsed mucosa was encountered in any particular systemic disease.

4. Because of the high incidence of this finding in patients without symptoms, it is concluded that the clinical significance of gastric prolapse has been over-emphasized, and that it is seldom the cause of symptoms.

NOTE: We gratefully acknowledge the assistance of Drs. Edward A. Gall and Leon Schiff in the preparation of this manuscript.

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SUMARIO

Prolapso Asintomático de la Mucosa Gástrica

En 100 enfermos que no tenían síntomas gastrointestinales, se ejecutaron estudios roentgenológicos de la porción superior del tubo gastrointestinal. En 18 de ellos se descubrió prolapso de la mucosa gástrica: leve en 10, moderado en 6 y pronunciado en 3. No se observó mayor aumento de la frecuencia en ninguna enfermedad orgánica dada.

Por virtud de la alta incidencia del prolapso de la mucosa gástrica en sujetos asintomáticos, dedúcese que se ha exagerado la importancia clínica del mismo y que rara vez ocasiona síntomas.

Rupture of the Spleen: Roentgen Diagnosis[1]

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THE DIAGNOSIS of ruptured spleen is important because of its high incidence and mortality rate. In cases treated medically or by delayed surgery (1, 2) the death rate, according to the most conservative estimates, is above 75 per cent. Failure to recognize the condition probably accounts for its apparently low incidence among hospital admission diagnoses. During the five-year period 1945–49, only 11 cases of ruptured spleen were recorded among 62,850 admissions to the Jewish Hospital of Philadelphia, which has a relatively inactive accident service. At the Chester County Hospital (West Chester, Penna.), located in a rural area with a fairly high rate of agricultural and automobile accidents, the incidence rate for the same period was three times as high, 9 cases among 21,655 admissions. The probable bearing of trauma on the incidence is further illustrated by the report of Wright and Prigot (3), who found 30 cases among 20,000 admissions to the traumatic service of Harlem Hospital (New York) in eleven years, and by that of Welch and Giddings (4) at the Massachusetts General Hospital, where among 3,154 cases of abdominal injury involvement of the spleen was encountered in 30 instances.

Promptness in making the diagnosis and in carrying out surgery are essential to survival. In Wright and Prigot's series, 51 per cent of the patients died within one hour following injury. Errors in clinical diagnosis and negative or equivocal roentgenologic studies indicate the necessity of improving technics for the demonstration of an injured and bleeding spleen.

ROENTGEN SIGNS OF RUPTURED SPLEEN

Among the criteria for the roentgenographic recognition of ruptured spleen is dilatation of the stomach, with a ragged, serrated appearance of the greater curvature (7–9). Gastric dilatation was seen in 7 of the 15 cases here reported and is a valuable sign when it occurs. Prominent rugae in the gastric cardia and serration of the greater curvature occurred in 6 cases, but these signs are difficult to evaluate, since they may occur in the absence of trauma (10).

A more widely used criterion is elevation of the left dome of the diaphragm (2, 3, 5, 9, 11–14), but in no case in this series was this observed. While the left diaphragm may be elevated by pressure of a hematoma, and tenting of the left leaf may occasionally be caused by perisplenic bleeding, profuse hemorrhage from a ruptured spleen may take place without the formation of a hematoma and without causing pressure on the diaphragm, so that reliance on this symptom may result in failure to recognize the condition.

Hodges (17) has suggested that downward displacement of the gastric cardia might be due to upward and medial encroachment by the spleen, or the interposition of fluid between otherwise normally disposed upper abdominal viscera and the diaphragm. Insufficient attention to this sign seems to have been given in cases of suspected rupture of the spleen. In reviewing the films available in our cases, however, such displacement was seen in only 2 cases. Furthermore, even this sign can be misleading. Splenic impression on the gastric walls may be without significance, being due simply to normal variations in the relative position of the organs, as pointed out by Hodges himself. In cases of suspected splenic hemorrhage, however, a check against this possibility could be obtained by *frequent re-examina-*

[1] From the Radiologic Services of the Jewish Hospital, Philadelphia, and the Chester County Hospital, West Chester, Penna. Accepted for publication in March 1951.

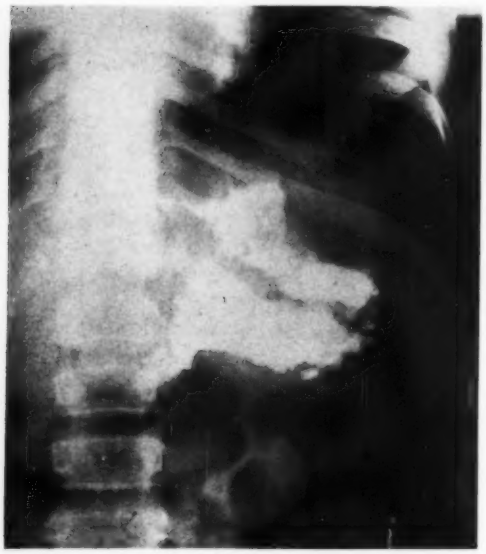


Fig. 1. Barium-filled stomach with patient in Trendelenburg position, revealing medial outline of the spleen. This examination repeated might show progressive changes diagnostic of bleeding spleen.

tions, which might demonstrate an increasing compression of the gastric cardia.

The presence of free fluid between the loops of the intestines, which Webb (11) considers significant, is not easily evaluated and is to that extent unreliable. This sign was discerned once in our series of 15 cases. Obliteration of the splenic shadow by a hematoma (7) was observed in 4 cases, but a dense shadow under the left leaf of the diaphragm (3) was never seen. Displacement of the stomach to the right was seen once and compression of the fundus (16) 3 times. Downward displacement of the splenic flexure was noted in 4 instances, but normally the splenic flexure is not infrequently found below the lower pole of the spleen.

In only 2 of our 15 cases did the roentgenologist's report fail to mention a possible splenic injury. An allusion to such a possibility was made in 7 of the cases and ruptured spleen was suspected or diagnosed in the remaining 6 cases. Since positive diagnostic signs were not uniformly found and since the same signs are found frequently in normal cases, evaluation for diagnostic purposes becomes difficult. A careful review of our findings led us to conclude that the roentgenologist had not yet evolved a set of signs which could be considered uniformly reliable, although some signs occur in most cases and thus furnish diagnostic aid.

Attempts have been made to demonstrate a ruptured spleen by the injection of contrast medium, but thus far these have been unsatisfactory, largely because of the time required for the organs to become visible. Burke and Madigan (6) obtained a shadow heavy enough for diagnosis by injecting one-half the usual dose of thorotrast (thorium dioxide), but the film could not be taken until four hours after the injection. A further objection to this procedure is the long continued radioactivity of the retained contrast medium.

Until some specific means is available for more accurate x-ray diagnosis of ruptured spleen, the roentgenologist could improve his technic by supplementing the anteroposterior view by several oblique views of the splenic area (Figs. 6 and 7). If these fail to demonstrate splenic irregularities, he could make exposures immediately after inspiration and expiration, thus showing slight immobility of the left dome, which may have much diagnostic significance; or the splenic shadow might be seen to better advantage with downward displacement of the diaphragm. If these methods do not demonstrate enlargement of the spleen and displacement of surrounding organs with restricted motion of the left dome, he could fill the stomach with barium, tilt the patient to the Trendelenburg position, as advised by Bancroft (15), and note whether the greater curvature of the stomach is displaced by a distended spleen (Fig. 1). If these measures are unsuccessful, the colon might be filled with air or barium as far as the splenic flexure, to determine if it is displaced by the spleen. This measure is reserved until the last, since we agree with Wright and Prigot that a preoperative enema should not be given to patients with suspected rupture of the spleen because of the possibility of dislodging the friable clot.

Planigraphy might prove very helpful. Finally, retroperitoneal air injection *via* the presacral angle (16) could be tried. This would delineate well the space between the spleen and kidney and, if rupture of the kidney is also suspected, this technic could be combined with urography (Fig. 2).

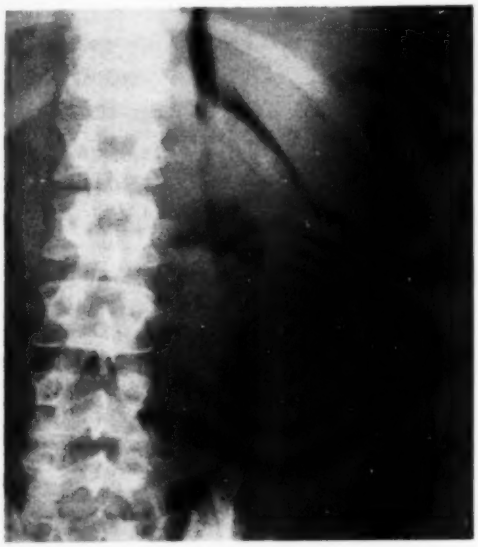


Fig. 2. A single injection of oxygen into the presacral retroperitoneal space outlines the kidneys and the space between the kidney and the spleen. This simple measure should prove useful in the diagnosis of hemorrhage from a torn spleen.

The roentgen findings in the 15 cases are presented in Table I, and 5 cases have been selected for fuller presentation.

TABLE I: ROENTGEN SIGNS OF SPLENIC RUPTURE IN 15 CASES

Roentgen Signs	Number of Cases
Roentgen signs absent	2
Dilatation of stomach	7
Prominent rugae or serrated gastric margins	6
Elevated left dome	0
Downward displacement of gastric cardia	2
Displacement of stomach to right	1
Downward displacement of splenic flexure	4
Compression of fundus	3
Separation of intestinal loops by free fluid	1
Obliteration of splenic shadow	4
Dense shadow under left dome	0
Displacement of stomach to left	1
Complications	
(a) Fractured ribs	2
(b) Torn diaphragm	1
(c) Blood in urine	1
Delayed hemorrhage	2

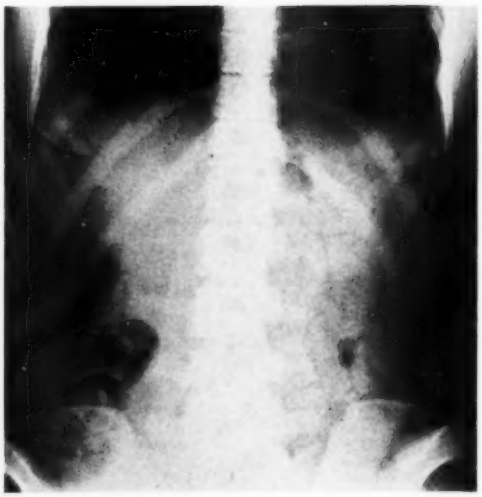


Fig. 3. Case I. Postero-anterior view of ruptured spleen. The small gastric air bubble is displaced slightly to the right. This possibility must be duly realized in the diagnosis of ruptured spleen.

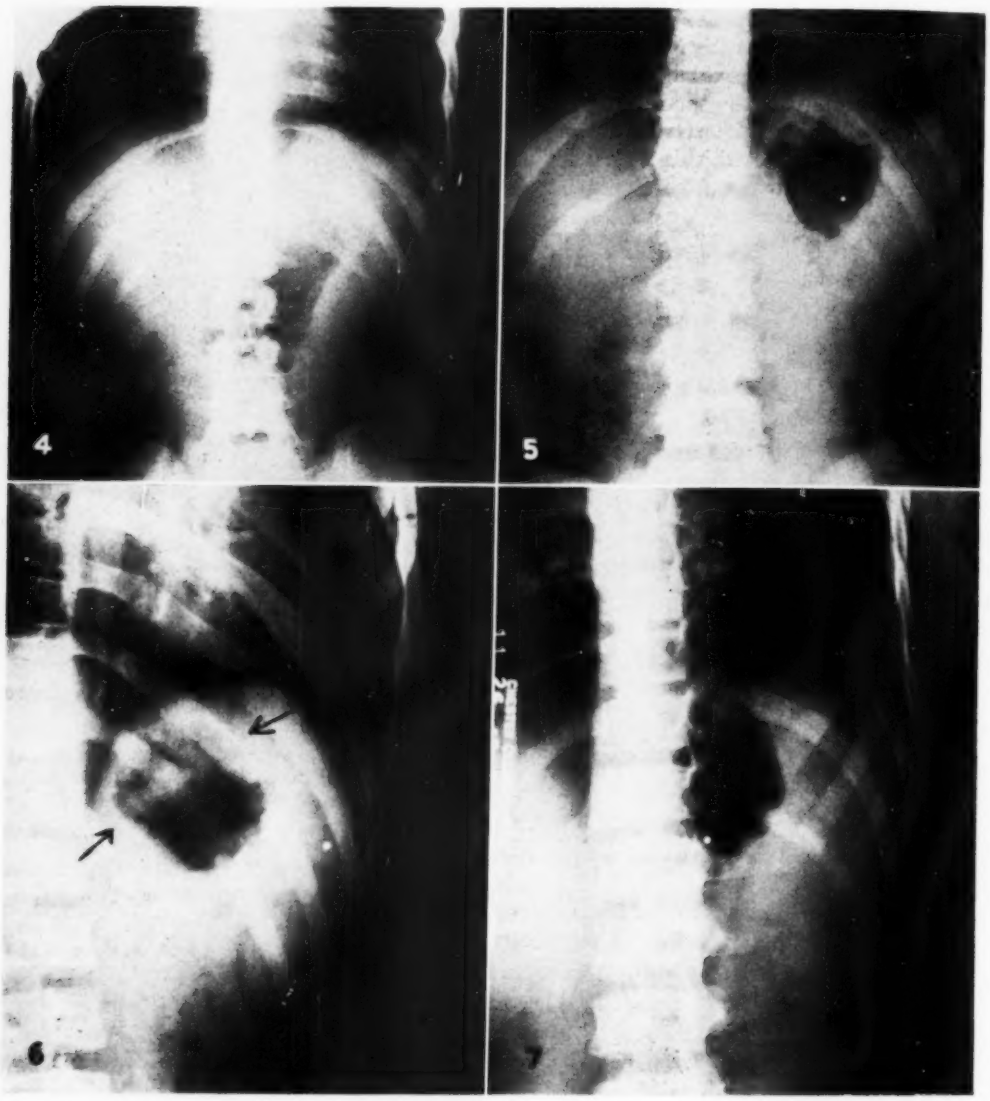
ILLUSTRATIVE CASES

CASE I: F. S., female aged 21, was struck in the region of the lower left anterior ribs by the steering wheel of her car during a collision, and was brought to the Chester County Hospital on March 1, 1950. X-ray examination revealed no fractured ribs. The splenic flexure of the colon, which seemed filled with fecal matter, was lower than usual. The small compressed gastric air bubble was displaced downward from the left diaphragmatic dome and also slightly to the right (Fig. 3). A ruptured spleen was removed at operation, and an uneventful recovery followed.

CASE II: P. R., male aged 14, was admitted to the Chester County Hospital at 11:45 A.M., Nov. 26, 1949. While playing in the woods about 10 A.M., he caught his foot in a vine and fell, striking his left side against a log. Pain occurred in the left side, but he walked home, where he collapsed. His mother called a doctor who, suspecting a ruptured spleen, referred the patient to the hospital.

On admission, he complained of considerable pain in the abdomen and in the left shoulder, associated with difficulty in breathing deeply. The upper left quadrant of the abdomen was tender and rigid. The blood pressure on admission was 104/60, erythrocytes 4,970,000, leukocytes 8,900. At 1 P.M these values were, respectively, 110/70, 4,630,000, and 14,900.

The roentgenologist reported serration of the gas-filled stomach, but nothing otherwise unusual to support a diagnosis of ruptured spleen. Operation was performed at 4 P.M., when a torn spleen was sutured. The postoperative course was uneventful.



Figs. 4–7. Case II. Fig. 4. Anteroposterior view. The downward displacement of the gastric air bubble may have been due to free blood around the upper pole of the spleen; but in the supine position, if the stomach is not completely distended, the air is apt to fill only the pars media and pylorica instead of the cardia, and this may cause an erroneous diagnosis of abnormal displacement.

Fig. 5. Postero-anterior film, showing a different position of the gastric air bubble than in the anteroposterior view. The prominent rugae may signify perigastric blood, but such changes are also seen normally.

Fig. 6. Recumbent left posterior oblique view, showing a shadow across the cardiac gas bubble which may have been due to the collection of free blood found at operation.

Fig. 7. Recumbent right posterior oblique view, showing disappearance of shadow seen through the cardiac gas bubble in Fig. 6. This phenomenon may be due to a shifting of the collection of free blood from the left to the right paraspinal gutter, a finding which might be the equivalent of Ballance's clinical sign.

On a review of the films in this case the gastric air bubble is seen to assume a relatively different position in the supine and prone positions. It appears displaced downward in the supine position (Fig. 4). In the prone position, serrations of the

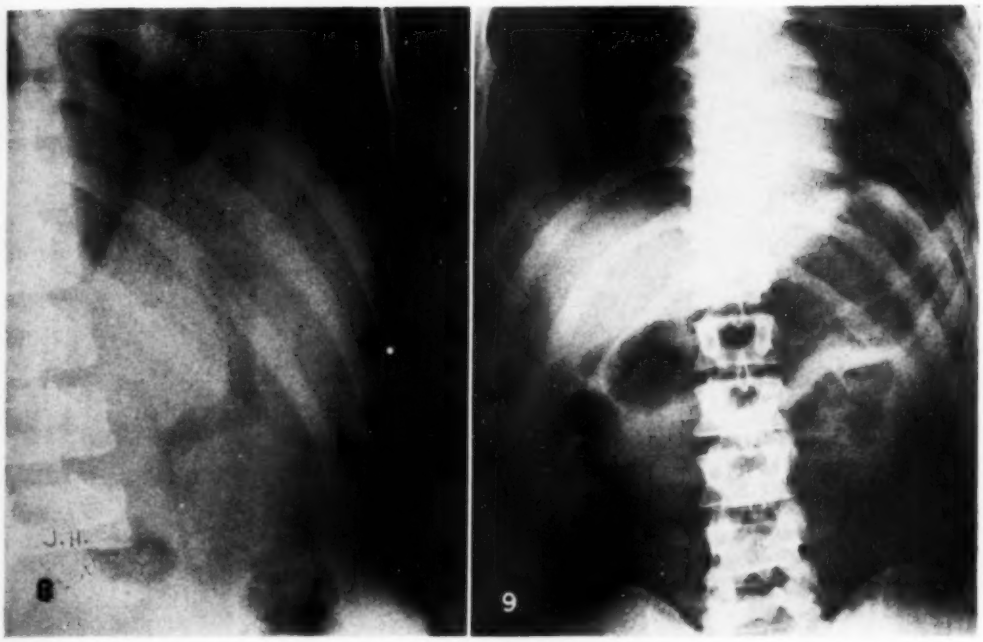


Fig. 8. Case III. Left posterior oblique view of torn spleen. The stomach contains little air, the margins are not serrated, but the fundus seems slightly displaced to the right by a perisplenic hematoma. (The small lead shot marks the point of greatest tenderness on the skin.)

Fig. 9. Case IV. Delayed splenic hemorrhage occurring five days after injury. The stomach is distended; the cardiac rugae are prominent; the space between the greater curvature and adjacent small intestines seems increased, which might have been due to blood in the peritoneum. The splenic shadow is not enlarged, however, and there is no apparent pressure on the stomach.

cardia are prominent, but these changes could be confused with normal variations (Fig. 5). In the left posterior oblique recumbent position, (Fig. 6) an oblique density is seen traversing the upper portion of the gastric air bubble, which might represent free blood, since the shadow disappears when the patient is rotated and examined in the right posterior oblique position (Fig. 7). This observation may possibly be the roentgen equivalent of Ballance's clinical sign.[2] If this phenomenon can be confirmed, it might prove to be of diagnostic value.

CASE III: J. H., a male aged 11, was admitted to the Chester County Hospital at 10:45 P.M. September 10, 1949. About three hours previously he had been thrown from his horse and had lain quietly on the ground for some time because of difficulty in breathing, but he had not felt faint and had not been unconscious. He then walked home and was taken by his parents to the family physician, who advised hospitalization.

The child was not in shock and could mount the examination table without evidence of pain or distress. The only finding was slight tenderness along the left costal margin and the anterior axillary line. Peristalsis was unusually active. The blood pressure was 116/70, pulse 120, and leukocyte count 25,750. The tentative diagnosis was possible intra-abdominal hemorrhage.

A roentgen examination made on the day following the injury showed only the presence of a moderate amount of gas in the large intestine, which partially obscured the soft tissues of the abdomen; there was no air under the leaves of the diaphragm. In the left posterior oblique view the outline of the spleen was distinct. The compressed gastric gas bubble revealed no prominent serrations of the margins, but the bulbous appearance of the lower portion of the spleen pressing on the stomach was possibly not duly appraised (Fig. 8). Operation was not decided upon until 4:40 P.M. on Sept. 12, the

[2] Ballance's sign: dullness to percussion in the left upper quadrant and in the left flank, with the appearance of dullness in the right flank on shifting of position, indicating the presence of a large amount of free blood.

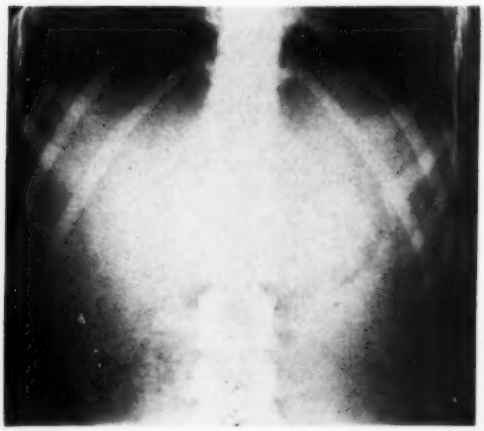


Fig. 10. Case V. Free blood in the peritoneum due to a ruptured spleen causing slight displacement of the stomach to the left. This was difficult to evaluate, since there is only a little air in the stomach, which otherwise was not distorted.

second day after the injury. Splenectomy was necessary because of a torn, bleeding spleen.

The postoperative course was stormy, and the patient died on the sixth postoperative day. Postmortem examination revealed volvulus of the ileum with gangrene.

CASE IV: The patient was an obese male, aged 47, who became dizzy and short of breath. He felt pain throughout the abdomen and in the left side of the neck and vomited twice while sweeping out his room *five days after* he had been kicked in the groin during a fight. The physical examination showed expansion of the chest to be slightly limited on the left, a hematoma and tenderness in the posterior left lower axillary line, moist râles in the lower left axilla, and a click on deep inspiration suggesting a broken rib. The abdomen was distended and was tender on slight palpation, more markedly so in the left hypochondrium, in which resonance was impaired. Peristalsis was hypoactive. A rectal examination showed tenderness similar to that in the abdomen. Paracentesis of the upper abdomen in three places was negative for free blood. The x-ray examination revealed a distended stomach and prominent cardiac rugal folds (Fig. 9).

Operation, approximately 16 hours after onset of symptoms, revealed a ruptured spleen. Splenectomy was performed, and recovery was uneventful.

This is a case of delayed splenic hemorrhage where the surgeon was alert and made a correct diagnosis with the help of the roentgen findings.

CASE V: M. B., a female aged 18, was admitted by ambulance to the Chester County Hospital at 5:30 P.M., Nov. 3, 1949. About 10:50 that morning, while playing hockey, she had run into the edge of a grandstand. She was breathless for a few minutes but did not lose consciousness. There followed immediately a sharp, severe pain spreading from the upper left quadrant throughout the abdomen, with vomiting of blood. The left upper quadrant showed marked resistance and tenderness. The abdomen was moderately soft. The roentgenologist reported no abnormalities of the lower thoracic cage as shown by anteroposterior, posteroanterior, and oblique projections. In the anteroposterior roentgenogram, the compressed gastric air bubble seemed displaced slightly to the left, possibly due to free blood in the left paraspinal gutter. The stomach was not dilated (Fig. 10).

Fig. 11. Case VI. Perisplenic collection of blood pressing on upper margins of the stomach. Bleeding was delayed until twenty days after rupture of the spleen.

Operation was performed at 7:25 P.M., when the spleen was found so badly torn that splenectomy was necessary. A tear in the left portion of the diaphragm about an inch and a quarter in length was sutured.

CASE VI: A female, aged 56 years, fell three feet from a stepladder, injuring her lower left thorax on the corner of a table. Acute pain occurred in the lower left anterior chest. An x-ray examination four hours later revealed fractures of the left 9th, 10th and 11th ribs. Red blood cells were found in the urine. The thorax was strapped with adhesive

tape and the patient was discharged within twenty-four hours, since no alarming symptoms and no abnormal signs or clinical findings became evident. Twenty days later, while doing her housework, she fainted. On admission to the hospital she was in mild shock, with blood pressure 90/40. The red blood cell count was 3,600,000, falling to 2,200,000 during the next twelve hours. There was continuous pain in the left upper quadrant which radiated substernally. An x-ray examination revealed downward displacement of the gastric air bubble (Fig. 11), and a diagnosis of ruptured spleen was made. This was confirmed at operation. A splenectomy was done, followed by recovery.

SUMMARY

The clinical diagnosis of ruptured spleen may be difficult. This is especially true in cases of delayed splenic hemorrhage. The positive roentgen signs of ruptured spleen are relatively few; rarely they may be absent altogether. Dilatation of the stomach, prominence of the rugae in the cardia, serration of the greater curvature of the stomach, and downward displacement of the gastric cardia and splenic flexure of the colon are signs which seem to occur more frequently than displacement of the stomach to the right, elevation of the left dome of the diaphragm, compression of the fundus, obliteration or increased opacity of the splenic shadow, or the demonstration of free blood in the peritoneum or mesentery.

Suggested improvements in the technic of x-ray examinations for suspected ruptured spleen comprise the use of oblique projections, with filling of the stomach and colon with contrast medium, barium or air; study of restricted motion of the left diaphragmatic dome during both phases of respiration, and *repeated studies* during the preoperative period of observation in order to detect progressive changes.

All injuries to the lower left chest or upper left abdomen should alert the roentgenologist to his responsibility for making these additional examinations when necessary. The finding of fractured lower left ribs or signs of injury to the left kidney should especially lead him to seek signs of possible splenic rupture.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Rotura del Bazo: Diagnóstico Roentgenológico

El diagnóstico clínico de la ruptura del bazo puede resultar difícil, máxime en los casos en que se demora la hemorragia esplénica. En dicho estado, los signos roentgenológicos positivos son relativamente pocos; y pueden hasta faltar del todo, aunque esto sucede raramente. La dilatación gástrica, la elevación de las arrugas en el cardias, la serración de la curvatura mayor del estómago y el desplazamiento hacia abajo del cardias y de la flexura esplénica constituyen signos que parecen ser más frecuentes que el desplazamiento gástrico hacia la derecha, la elevación de la cúpula izquierda del diafragma, la compresión del fondo gástrico, la obliteración o hiperopacidad de la imagen esplénica, o hallazgo de sangre libre en el peritoneo o el mesenterio.

Los perfeccionamientos propuestos en la técnica del examen roentgenológico cuando se sospecha rotura esplénica comprenden: uso de proyecciones oblicuas, con henchimiento del estómago y del colon con medio de contraste, bario o aire; estudio de la limitada movilidad de la cupula izquierda del diafragma durante ambas fases de la respiración; y estudios repetidos durante el período preoperatorio de observación a fin de descubrir alteraciones en vías de evolución.

Toda lesión de la porción izquierda inferior del tórax o izquierda superior del abdomen debe hacer recordar al roentgenólogo su obligación de ejecutar esos otros exámenes, si parecen necesarios. El hallazgo de fractura de las costillas inferiores del lado izquierdo o de signos de lesión del riñón izquierdo debe en particular hacerle buscar signos de posible rotura esplénica.

Combined Radiation Therapy and Surgical Treatment of Technically Inoperable Cancer[1]

GEORGE T. PACK, M.D., and THEODORE R. MILLER, M.D.

THE POSSIBLE combination of radiation therapy and surgical treatment has been a hopeful concept of the oncologist. Great advances have been made in the evolution of radiation therapy of cancer during the past twenty-five years. These accomplishments have been: first, the standardization of technics for x-ray and radium therapy; second, accuracy of dosage through better physical equipment, physical measurements, tumor-dose determination, etc.; third, improvement in equipment to employ voltages of various strengths under proper conditions; fourth, the large accumulated body of knowledge concerning the radiosensitivity of almost all cancers, the better knowledge of the natural history of each disease, and in many instances the determination of the lethal dose in terms of radiation units of treatment.

CHOICE BETWEEN RADIATION THERAPY AND SURGICAL TREATMENT OF CANCER

Indications for radiation therapy and for the surgical treatment of cancer have become more clearly defined, although for cancers in some locations, notably of the head and neck, the esophagus, and the uterus, considerable controversy exists concerning the choice of the two agents under certain conditions. Too often during previous years the two methods of treatment have been considered as rival procedures, with arguments presented to support the indications for each. In some instances, the two have been combined, but in a review of the known combinations, they are found usually to have been employed for early, favorable cases. Preoperative irradiation has long been advocated and experimented with, particularly for operable cancers of the breast, uterine cancer, and metastatic cancer in the neck secondary to intraoral lesions. Postoperative x-ray therapy has been employed as a supposedly prophylactic measure against recurrence, on the contention that residual cancer in small, isolated foci may be destroyed or encapsulated in a state of abortive fibrosis, thus delaying the reappearance of the disease.

CONJOINED IRRADIATION AND SURGICAL TREATMENT OF CANCERS PREVIOUSLY CONSIDERED INOPERABLE

Although the definition of operability has been broadened, there are still local situations in which cancers must be considered inoperable even by the most radical surgeons. This discussion does not apply to cancers classified as inoperable because of distant dissemination or visceral metastases, but only to those neoplasms deemed inoperable because of local extent and technical difficulties. For these inoperable cancers the combination of radiation therapy and surgical treatment is essential, as it is our contention that either method alone would result in failure. In fact, the majority of patients included in this report were referred to us by other surgeons and hospitals with the pronouncement of inoperability. The argument presented is the use of irradiation for converting a technically inoperable and therefore hopeless cancer to one that is resectable. The results thus obtained have been palliative in every case and curative in many instances. Case reports will be included to defend this thesis.

Indications for Combination of the Two Modalities of Treatment: Cancers of the rectum and colon, fixed, immovable, subjected to previous unsuccessful attempts at resection, have been resected following a protracted program of x-ray therapy. Sarcomas of the soft somatic tissues, fixed

[1] From the Memorial Cancer Center, New York, N. Y. Read before the Sixth International Congress of Radiology, London, England, July 27, 1950. Accepted for publication in March 1951.

and inoperable even by such radical surgical procedures as hemipelvectomy, have received preoperative irradiation with high-voltage x-rays and radium element pack with subsequent radical dissection and cure, in some instances of ten years duration. A group of patients with cancer of the thyroid gland metastatic bilaterally to cervical nodes, fixed and inoperable, have been treated by a combination of irradiation and surgical excision with survivals of five to fifteen years. Malignant tumors of the maxillary antrum with fungation and invasion of the orbit, cheek, and oral cavity have received a combination of radiation therapy and surgical excision with ten years survival. Ovarian cancer frequently falls into this group. The patient presents herself with an inoperable, fixed tumor and ascites. Following radiation therapy, the tumor becomes movable and therefore operable. Lymphosarcoma limited to one node-bearing region may be made operable by preliminary irradiation.

The management may be so planned in some instances that flaps to close the resultant defect after surgical treatment are available, or the irradiation may be boldly given, with recognition of the fact that the overlying skin will be destroyed and that the defect will require excision and skin grafting. It requires a certain degree of vicarious courage intentionally to deliver an overdose of radiation to an advanced cancer. This willful production of radiation necrosis and ulceration in some cases is done only as part of a preconceived plan known to the patient, calling for subsequent removal of the regressive tumor and the damaged superjacent tissues. In some circumstances, notably in soft-tissue sarcomas, the actual cautery has been ruthlessly employed to excise the tumor widely and deeply. Combinations of gold radon seeds and radium needles in overdose technics have proved valuable. The program of irradiation should be carefully supervised and time allowed for maximal regression of the cancer prior to the surgical attack. This entails a post-irradiation interval seldom less than six weeks. In the case of our patients with colonic and rectal cancers, we have resisted the temptation to perform primary or immediate anastomoses at the time of post-irradiation resection.

For inoperable sarcomas of the soft somatic tissues, a definite pretreatment plan should be adopted with the knowledge and consent of the patient. Certain sarcomas, *e.g.*, the embryonal liposarcomas and some cellular synoviomas, have a high degree of radiosensitivity. During the program of protracted and intensive irradiation with overdosage, the clinical regression of the sarcoma may be so complete as to lull the patients into a false sense of security and cause them to refuse later surgical treatment. The planned post-irradiation excision should be done under all circumstances, as experience has demonstrated the survival of foci of viable sarcoma in a majority of cases so treated. The component cells of these sarcomas may vary greatly in their lethal end-points in respect to irradiation. For example, a dose of 1,000 r might destroy the majority of radiosensitive sarcoma cells, yet a tumor dose of 6,000 r might be necessary to sterilize the most radioresistant fraction.

Experience also suggests that the surgical dissection of these heavily irradiated sarcomas is less hazardous, as far as metastases are concerned, than when surgery is performed without primary irradiation.

CASE REPORTS

Two types of cases will be presented: those in which palliation was secured and those in which long-standing cure was accomplished.

CASE 1, *Recurrent, Inoperable Liposarcoma of the Thigh; 14-Year Cure* (Fig. 1): F. L., a 35-year-old white woman with three living children, discovered a mass in the right femoral triangle in February 1936. An attempt at surgical excision was abandoned by a surgeon, who encountered severe hemorrhage. No biopsy was taken. Some interstitial irradiation of unknown dosage was attempted at another institution, with little influence on growth of the tumor.

When we first saw the patient in October 1936, a mass measuring 14 × 16 cm. involved the right

femoral triangle and inguinal region, with extension superior to the inguinal ligament. The mass was semifixed, but did not involve bone. Huge cavitation of the wound, lined by tumor, prevented any primary effort at surgical dissection. There were no evidences of pulmonary metastasis. A biopsy was positive for sarcoma, of undetermined histogenesis. The superior limit of the tumor was so high that amputation of any type short of hemipelvectomy was considered to be impossible. The patient was therefore treated with the 4-gram radium element pack applied at 15 cm. radium-skin distance, with a filter of 0.35 mm. platinum and 1.5 mm. brass. Two hours daily exposure (8 gram hours) to the tumor was given. Treatments were continued from Oct. 23, 1936, to Dec. 10, 1936, for a total of 252,000 mg. hrs. Slow, progressive diminution in size of the tumor, with healing of the fungation and ulceration took place.

On Jan. 8, 1937, a re-evaluation of the case was made and a radical surgical excision of the entire inguinal and femoral triangle was accomplished. No attempt was made to close the wound by approximation; the defect was covered with multiple split-thickness grafts. Healing occurred with great difficulty. The pathologist's report showed the tumor to be an adult type of liposarcoma which was badly damaged but still viable.

A marked elephantiasis chirurgica of the right lower extremity developed, requiring several Kondoleon operations to remove the excessive tissue in both the lateral and medial aspects of the leg. The patient is well and walking, without any evidence of recurrence to date, and with very good function of the leg.

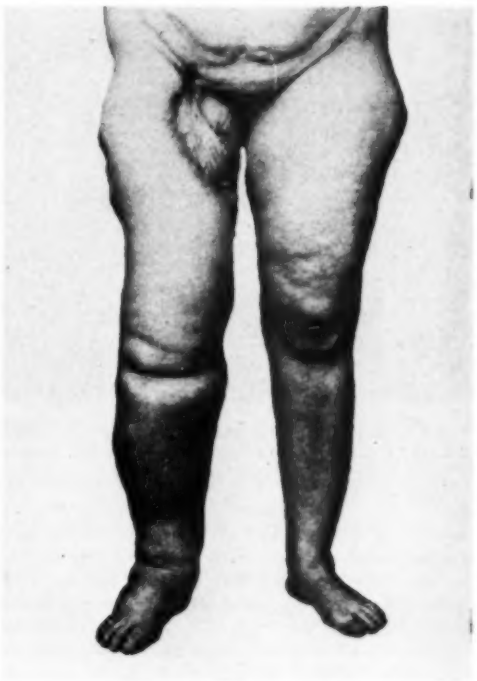

Fig. 1. Case 1: Recurrent inoperable liposarcoma of the thigh. Preoperative irradiation; radical surgical excision; Kondoleon repair of lymphedematous extremity. Fourteen-year cure.

CASE 2, *Rhabdomyosarcoma of the Buttock; 11-1/2-Year Cure:* R. R., a 25-year-old married woman, was first seen on May 6, 1939, with a mass in the left gluteal region of three months duration. Seven months earlier she had received a series of fourteen intramuscular injections of antuitrin-S into both gluteal regions. On examination, there was found in the left buttock, situated well beneath the skin, a very large, ovoid, smooth, non-tender tumor. It was only slightly movable, with deep adherence, and occupied the greater part of the buttock, extending across the midline. Aspiration biopsy showed the tumor to be of sarcomatous nature. The presence of multinucleated giant cells suggested the possibility of rhabdomyosarcoma.

Preliminary irradiation was administered with the 4-gram radium element pack, at 15 cm. radium-skin distance, with a 6-cm. cone, filter of 0.35 mm. platinum and 1.5 mm. brass. A dose of 8,000 mg. hr. was administered daily for nineteen consecutive days, totaling 152,000 mg. hr. Six weeks later, a radical resection of the buttock was performed. At this time, the tumor was found to be loosely attached to the fascia and periosteum of the sacrum.

Gross pathologic examination of the specimen revealed a pseudo-encapsulated tumor measuring 15 × 10 × 7 cm. It had a heterogeneous structure, partly broken down and cystic and partly fibrous. Some regions were edematous and others contained yellow necrotic or brownish-red infarcted hemorrhagic material. The microscopic diagnosis was rhabdomyosarcoma, Grade III.

Convalescence was uneventful. For a period of one year following the radium therapy, the patient was amenorrheic. Menstruation later became normal, and pregnancy occurred in 1942, with delivery of a normal child. Two years later the uterus was found to contain three very large fibromyomas, which were enucleated surgically. A second pregnancy followed, with successful delivery. Now, eleven and a half years after the initial treatment, the patient is living and well, without evidence of recurrence or metastasis, and without disability.

CASE 3, *Rhabdomyosarcoma of Chest Wall; 4-1/2-Year Survival* (Fig. 2): J. H., 50-year-old white male, fell on Nov. 17, 1944, striking his left chest wall against the door of an automobile. Roentgenograms were uninformative. Pain persisted. In February, 1945, a small mass appeared at the reputed site of the trauma. On July 31, 1945, a local excision was done, but by September a massive recurrence had

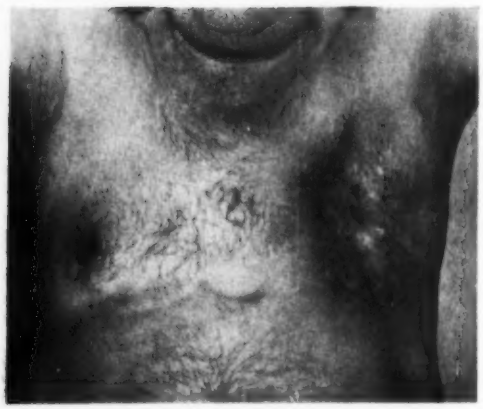

Fig 2. Case 3: Rhabdomyosarcoma of chest wall. Radiation therapy and surgical excision. No evidence of recurrence after four and a half years.

appeared. In October of the same year, x-ray therapy was administered elsewhere (factors unknown). In February 1946, a second operation was done in another city, at which time a mass the size of a grapefruit was removed, together with three underlying ribs. Extirpation was known to be incomplete, because the pericardium was involved. There was immediate recurrence with massive fungation and hemorrhage. When first seen by us in June 1946, the patient was taking a grain of morphine every four to six hours. He was having repeated hemorrhages, and a foul, necrotic, fungating mass was present, involving the left chest wall in the precordial region.

The fungating mass was removed with the actual cautery on June 10, 1946. Two days later, high-voltage x-ray therapy was begun, with the following factors: 250 kv., 50 cm. target-skin distance, 1.5 mm. Cu, 25 ma., port 20 × 20 cm.; 300 r were given daily for a total dose of 3,000 r in air. On July 2, 1946, thirteen gold-filtered radon seeds were inserted in the region beneath the eschar, for a dose of 17.7 mc. destroyed (2,351 mc. hr).

The pathologist's report showed undifferentiated rhabdomyosarcoma. The pleura and pericardium were exposed over a large area, but gradually epithelialized. The patient is now living and well and weighs 254 lb. The underlying lung can be seen through the thin overlying skin.

CASE 2, *Myxosarcoma of Neck; 10-Year Survival:* H. G., a 28-year-old white male, in 1939 discovered a mass in the left posterior nuchal region. A local excision was done elsewhere in the spring of 1940, and in March 1941 the tumor was found by us to involve the posterior triangle and musculature of the right side of the neck. It was firmly fixed to the spine. The sarcoma had been pronounced inoperable.

The patient was treated from March 15 to April 8, 1941, with the 4-gram radium element pack, through a 10 cm. circular portal at 10 cm. radium-skin distance, with filter of 0.35 mm. of platinum and 1.5 mm. brass, 4,000 mg. hr. being given daily for a total dose of 100,000 mg. hr. On May 22, 1941, after the mass had become movable, a radical excision was carried out. The patient had a severe anemia and his convalescence was prolonged. By Dec. 1, 1941, he was in good physical condition and he has remained well since that time, for a survival period of ten years. There is no evidence of recurrence or metastasis.

CASE 5, *Lymphosarcoma of Right Axilla; 3-year Survival:* A. V., a 34-year-old white male, was first seen in January 1948. He had observed a rapidly growing mass in the right axilla for a period of three weeks. He was otherwise in excellent health. On physical examination, a large, bulky tumor was found, distending the axilla and pushing the pectoralis major muscle forward and upward. Aspiration biopsy suggested that the tumor was a lymphoma. Because the disease appeared to be limited to one node-bearing region, surgical dissection was considered the method of choice, but operability was questionable because of the enormous bulk of the tumor.

The patient was given x-irradiation, at 250 kv., 25 ma., and 50 cm. target-skin distance, with 1.5 mm. copper filter, 350 r being administered daily, alternating through two large portals (18 × 14 cm.) directed toward the axilla. Over a period of twelve days 1,650 r in air were administered to each field. Six weeks later, on Feb. 20, 1948, a radical axillary dissection was done, with removal of the breast, pectoral muscles, and contents of the axilla. Microscopic study of the specimen showed the tumor to be markedly necrotic, but still viable and recognizable as lymphosarcoma. The patient has remained well for three years without further evidence of his disease.

CASE 6, *Carcinoma of the Left Antrum; 9-1/2-Year Survival:* M. S., a 53-year-old white female, was first seen on June 24, 1941. She related the following history. On the removal of a tooth in 1938, a cyst was found to be present in the left superior maxilla. The supposed cyst was drained at the time, again in March 1939, and again in 1940. During the winter of 1941, the antral cavity continued to fill with purulent granulation tissue. The patient came primarily for a solution of her problem of persistent sinus drainage.

On examination, a large squamous cancer was found involving the left antrum, floor of the orbit, nasal cavity, and cheek, with fungation in the left gingivo-buccal gutter. At that time the cancer was considered to be inoperable because of its extent. X-ray therapy was begun, with 250 kv., 25 ma., and 1 mm. Cu filter, at 50 cm. target-skin distance,

to two portals (6 × 6 cm. each) over the left superior maxilla. A total of 4,500 r in air was delivered to each port, following which good regression occurred. On Aug. 4, 1941, the patient was admitted to the hospital, where a cautery antrotomy and cautery removal of the bulk of the tumor were done. Three 50-mg. tubes of radium were then inserted into the cavity for ten hours, for a total dose of 1,500 mg. hr. The cavity was completely epithelialized by August 1941, and the patient has remained in good health since that time.

CASE 7, *Ovarian Carcinoma; 3-Year Survival:* M. M. was 23 years old when first seen in March 1948. She had been explored in another institution for what was thought to be tuberculous salpingitis, but was found to have an inoperable carcinoma of the ovary. When we first saw her, the abdomen was distended with ascitic fluid, and a large mass was found occupying the entire pelvis. The cancer was deemed inoperable, and the patient was therefore given x-ray therapy, at 250 kv., 2,100 r in air being delivered to each of two anterior ports measuring 18 × 12 cm., at 70 cm. target-skin distance, filter of 1.5 mm. copper. Several abdominal paracenteses were done, with removal of 7,000 to 8,000 c.c. of fluid.

The patient was admitted to the hospital on May 21, 1948, following which the tumor was removed by a radical panhysterectomy and bilateral salpingo-oophorectomy. She is now free of any evidence of her original ovarian cancer. The tumor was reported as a papillary cystadenocarcinoma, Grade II plus.

CASE 8, *Granulosa-Cell Tumor of Ovary; 1-1/2-Year Palliation:* R. D., a 42-year-old white female, when first seen in March 1948, related the following history. For three to four months prior to consulting her physician in February 1948, she had experienced abdominal discomfort, accompanied by low backache. On pelvic examination, a large mass was found in the left lower iliac quadrant. An exploratory laparotomy was done on March 11, and the omentum as well as the peritoneum was found to be studded with metastases. A large pelvic mass, the origin of which could not be determined, was found, and because of its fixity was considered inoperable. Biopsy showed a granulosa-cell tumor of moderate malignancy.

The patient was given 300 r × 5 to each of four pelvic portals (18 × 14 cm.), at 1,000 kv., with 3.8 mm. lead filter and 70 cm. target-skin distance. She received testosterone daily in 100-mg. doses until 3 grams had been administered. She tolerated the radiation therapy moderately well. In August 1948, she was admitted to the hospital and a panhysterectomy was done. Recovery was uneventful, and the patient remained well until June 1949, by which time she had gained 25 lb. in weight. She experienced no gastro-intestinal distress, and had returned to her job. Later, the abdominal pain recurred, and in July 1950 massive recurrence with ascites was discovered. Additional x-ray therapy was given without palliative relief, and death occurred on Sept. 7, 1949.

This case is presented to illustrate what can be accomplished in the way of short-time but worth-while palliation by a combination of irradiation and surgical excision in an originally hopeless situation. A full year of comfortable living was given to this patient, surely a worth-while reward for our efforts. This type of short-term palliative relief probably represents the average measure of relief afforded by the judicious use of the combined surgical and radiation methods.

CASE 9, *Carcinoma of Splenic Flexure: 2-Year Palliation:* H. L., a 45-year-old white male, when first seen in December 1947, gave a history of colicky pains in the lower abdomen for the past six months. The pain was accompanied by frequent loose stools but no blood. Several x-ray studies were said to be normal. Proctoscopic examination was normal. About eight weeks prior to admission, the patient had experienced an acute attack of pain in the left upper quadrant while eating. Within twelve hours the temperature had risen to 101° F., and continued at this point almost daily. A barium enema revealed a mass in the splenic flexure, diaphragm, and chest wall. Because of its fixity, it was considered inoperable. The patient therefore was given high-voltage x-ray therapy through anterior and posterior abdominal portals (18 × 18 cm.) directed at the tumor. He received 2,100 r in air × 2, at 250 kv., 70 cm. target-skin distance, with 1.5 mm. copper filter. On March 1, 1948, a resection of the splenic flexure of the colon, chest wall, spleen, and greater curvature of the stomach was done *en bloc*. The colostomy was closed, and following a stormy period of convalescence, the patient was discharged from the hospital on April 14, 1948. He gained weight, from 95 lb. when he was discharged to 122 lb. during the next year. His convalescence was not complete, but he was able to work during this time.

In August 1949, the patient was found to have a spontaneous vesicorectal fistula, and the pelvic induration which had been present since the operation had increased. He was therefore admitted to the hospital for an exploratory laparotomy, at which time metastatic cancer was found in the cul-de-sac, associated with the rectovesical fistula. Death occurred eighteen months after the resection of the splenic flexure; on necropsy there was no evidence of residual cancer in the upper abdomen, from which the originally inoperable tumor had been removed.

This case history is presented as an illustration of a two-year palliation of carci-

noma of the colon, the result of combined x-ray and surgical treatment.

CASE 10, *Carcinoma of the Thyroid with Bilateral Metastases to Cervical Nodes; 11-Year Survival:* F. F. was 29 years old when first seen in March 1940, at which time she related the following history. In February 1939, a supposed thyroid adenoma, which had been present for four years, was excised in another institution. Following the excision and histologic study, she was given forty x-ray treatments with factors unknown to us. It is interesting to note that, although she had been aware of the nodule in the thyroid gland for four years, it did not begin to grow until two years prior to her admission, when she was pregnant for the first time.

On our first examination, in March 1940, the right cervical chain of lymph nodes was found to be enlarged, and a similar hard, fixed mass was found in the left supraclavicular space. A roentgenogram of the chest was normal. The patient was accordingly given 72,000 mg. hr. with the 4-gram radium pack, at 10 cm. radium-skin distance, with a 7 cm. cone. This treatment was started on March 25, and completed on April 11, 1940. The left neck was then given 2,300 r in air to each of two portals, (10 × 10 cm.) centered over the obvious metastatic cancer, at 200 kv., with 0.5 mm. copper filter and 35 cm. target-skin distance. In October 1940, the patient was admitted to the hospital, where a right partial neck dissection was done. The specimen showed alveolar carcinoma of the thyroid. Convalescence was somewhat prolonged because of the heavy irradiation, but by June 1941, the wound was completely healed and there was no evidence of cancer. The patient has been observed at intervals since that time, and remains free of all evidence of thyroid cancer to date. A basal-cell epithelioma recently developed on the skin of the face and has been excised.

CASE 11, *Advanced Inoperable Thyroid Cancer; 16-1/2-Year Survival:* D. B. was 12 years old when first seen in August 1934, at which time she had had enlarged cervical lymph nodes for two years. Biopsy was done, showing metastatic carcinoma of thyroid origin. A mass weighing 12 grams was removed from the right lobe of the thyroid and reported as showing solid and small alveolar carcinoma of the thyroid.

When first seen at Memorial Hospital, the patient was a well developed 13-year-old girl weighing 80 lb. The only significant findings were in the neck, where large fixed lymph nodes were found scattered throughout both sides.

The extent and fixity of the primary thyroid lesion and the involved lymph nodes led us to declare the tumor inoperable. The patient was therefore given 2,100 r in air to each of three portals (10 × 10 cm.), one directed to the left side of the neck and two to the right side, in fractions of 300 r, with 200-kv. high-voltage apparatus (filter 0.5 mm. Cu; 50 cm. target-skin distance). When the severe wet reaction had subsided, the residual masses were exposed and gold seeds were inserted for a total dose of 14.3 mc. destroyed. Tissue removed at this time was reported as showing adenocarcinoma of the thyroid.

In April 1935, the patient began to complain of headache, which became so severe that neurologic consultation was sought. She was found to have choking of the left disk and a spinal fluid pressure of 360 mm. of water. Ventriculograms revealed a large tumor in the left lateral ventricle. Because the thyroid cancer appeared to be controlled, and because of the theoretic possibility that an independent brain tumor might exist, craniotomy was performed by Dr. Byron Stookey. At operation, a mass appearing to be a tumor of the choroid plexus which had blocked the posterior horn of the left lateral ventricle was removed. On histologic examination this proved to be metastatic thyroid cancer.

In October 1945, this patient was delivered of a normal child and appeared well in every way. She is now the mother of two daughters and is living without recurrence more than sixteen years since the treatment of her advanced thyroid cancer.

CASE 12, *Inoperable Rectal Cancer; 11-1/2-Year Survival:* H. G., 61 years old when first seen in 1939, related the following history: He had suffered increasing constipation since June 1938. On examination, a locally inoperable cancer of the rectum was discovered; this cancer was given x-ray therapy because of its fixity and technical inoperability. Roentgen irradiation was followed by the interstitial use of gold radon seeds in measured tissue dosage. This treatment was administered at another institution.

When we first examined the patient six months later, the rectum was contracted and ulcerated, with discharge of blood and mucus. Fixation of the rectum was evident posteriorly, and there was some question as to the possible involvement of the prostate gland. The patient was markedly emaciated and the rectum partly stenosed. A temporary loop colostomy employing the transverse colon was performed. The discomfort was relieved by the introduction of 20 c.c. of 20 per cent alcohol within the sacral canal. Four months after the colostomy was performed the patient was readmitted to the hospital and at this time a perineal resection of the rectum was performed. The excised specimen showed a residual adenocarcinoma, Grade II, but the bulk of the tumor had been destroyed by the previous combined external and interstitial irradiation, and the rectum as a whole was movable and technically resectable. The operation was considered to be of only palliative benefit in view of the advanced local stage of the disease at the time treatment was started.

The patient has gained weight and remained well. He is now 72 years of age, weighs 172 pounds.

and has had recent medical treatment for a bleeding duodenal ulcer. There is no evidence of residual rectal cancer, eleven and a half years after treatment.

CASE 13, *Recurrent Inoperable Retroperitoneal Liposarcoma; Successful Surgical Dissection Following Irradiation:* J. M. had a retroperitoneal tumor excised at an institution in another state on Jan. 6, 1949. The neoplasm was reported as fibromyxoliposarcoma. In August 1949, a recurrence of the tumor was discovered at this clinic; the patient was told that the recurrent tumor was inoperable and no further treatment was considered feasible. Shortly thereafter he experienced severe pain in the right lower back, radiating down the right leg. On examination, a huge mass was found in the right lower abdominal quadrant, extending into the pelvis and upward to the lower pole of the right kidney. These masses were fixed and multilobular, occupying the right paravertebral gutter. The enormous tumor filled the entire right half of the abdomen and pelvis. It was obviously technically non-resectable.

The million-volt x-ray apparatus was employed, with 70 cm. target-skin distance and 3.8 mm. lead filter, 300 r being given on consecutive days, alternating between two huge anterior and posterior fields (18.5 × 18.5 cm.), for a total dose of 3,000 r in air × 2. The x-ray therapy was completed in September 1950. Six weeks later the liposarcoma had regressed more than 50 per cent in size and had become quite mobile. A retroperitoneal dissection was done and the tumor removed without great technical difficulties. The patient has remained well.

This case is presented to illustrate the conversion of an obviously inoperable and recurrent liposarcoma to an operable state through the intermediation of preliminary x-ray therapy.

SUMMARY

Although the definition of operability has been broadened, there are still situations in which cancers must be considered inoperable, even by the most radical surgeons, because of the local extent of the growth and technical difficulties of removal. In such cases the combination of radiation therapy and surgical treatment is essential, the irradiation converting a technically inoperable and therefore hopeless cancer to one that is resectable.

Two types of cases are presented here in which combined irradiation and surgery were used: those in which palliation was obtained and those in which long-standing cure—up to sixteen years—has been accomplished. Included are cases of cancer of the colon and rectum, sarcoma of the soft somatic tissues, thyroid cancer with cervical node involvement, malignant tumor of the maxillary antrum with invasion of the orbit, cheek and oral cavity, ovarian carcinoma, and lymphosarcoma of the axilla.

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SUMARIO

Combinación de la Radioterapia y el Tratamiento Quirúrgico en el Cáncer Técnicamente Inoperable

Aunque ha sido ampliada la definición de operabilidad, restan todavía situaciones en que, debido a la extensión local del tumor y a las dificultades técnicas que rodean a la extirpación, hasta los cirujanos más radicales tienen que considerar como inoperable el cáncer presente. En esos casos, resulta indispensable la combinación de la radioterapia y la cirugía, convirtiendo la primera en resecable un cáncer técnicamente inoperable y por lo tanto desahuciado.

Preséntanse aquí dos formas de casos en que se usaron la irradiación y la cirugía combinadas: unos en que se obtuvo paliación y otros en que se han logrado curaciones prolongadas—hasta de dieciséis años. Entre ellos figuran casos de cáncer del colon y recto, sarcoma de los tejidos somáticos blandos, cáncer tiroideo con invasión de los ganglios cervicales, tumor maligno del seno maxilar con invasión de la órbita, la mejilla y la cavidad bucal, carcinoma ovárico y linfosarcoma de la axila.

Use of ACTH and Cortisone in the Treatment of Post-Irradiation Pulmonary Reaction[1]

STUART W. COSGRIFF, M.D., and MORTON M. KLIGERMAN, M.D.

WITH THE PRESENT trend toward higher radiation dosages in an attempt to control pulmonary, esophageal, and other thoracic lesions, the danger of producing post-irradiation pulmonary fibrosis has increased.

Adrenocorticotropic hormone (ACTH) has been reported by Kennedy *et al.* (1) as producing beneficial effects in a patient with beryllium pulmonary granulomatosis. West and his associates (2) have observed clinical improvement in two patients with pulmonary fibrosis who were treated with ACTH and cortisone. Because of these results, ACTH and cortisone have been recently employed in a patient in whom an unusually severe post-irradiation reaction in the lung occurred after roentgen therapy for a pulmonary metastasis. Inasmuch as the hormone appeared not only to halt but partially to reverse the *acute* phase of the reaction, it has seemed worth while to record this case.

G. K., a 68-year-old female, was referred in May 1950, for consideration of radiotherapy of a solitary metastatic nodule in the right middle lobe of the lung (Fig. 1).

In November 1945 this patient had undergone intestinal resection for carcinoma of the sigmoid colon. A small rounded shadow of increased density in the left mid lung field had increased gradually from that time until January 1949, when resection of the left lower lobe was performed. The nodule proved to be metastatic from the carcinoma of the colon. Following this operation, the patient had no pulmonary complaints.

A chest film in October 1949, ten months after the left lower lobectomy, revealed a single asymptomatic nodule in the right middle lobe, and by May 1950 this new nodule measured 4 cm. in diameter. After discussion of the possibility of resultant fibrosis and "radiation lobectomy," radical x-ray therapy was instituted.

Multiple small-port beam-directed x-ray therapy was used, following the plan of Winternitz and Smithers (3). The factors were 200 kv., 25 ma., 50 cm. target-skin distance, h.v.l. 0.9 mm. Cu. Eight anterior and eight posterior circular ports, each 8 cm. in diameter, were used, with cross-firing in such a manner as to "by-pass" the volume of tumor-bearing tissue. Each port received 2,250 r measured in air. A minimum tumor dose of 4,500 r was delivered in fifty-two days to a sphere-shaped volume of lung approximately 8 cm. in diameter. This included the nodule and the adjacent hilus. Treatment was concluded July 7, 1950.

Three days later (July 10) the patient again entered the hospital because of exhaustion, weakness, tachycardia, poor appetite, nausea, and vomiting. On admission her temperature was 100.8°, pulse 90, and respirations 20. X-ray examination of the chest on July 12, 1950, showed faint streaky shadows in the periphery of the right upper lobe compatible with either virus pneumonia or radiation fibrosis. Because these abnormal densities were well out of the area over which the 16 small ports converged, radiation fibrosis was considered less likely at this early date.

The patient's temperature continued to range between 100° and 102°. Dyspnea progressively increased. X-ray examinations repeated between July 10 (Fig. 2) and Aug. 12 disclosed progressive increase in density around the periphery of the lung. No subjective or objective improvement was noted during adequate therapeutic trials of penicillin, streptomycin, aureomycin, terramycin, and sulfadiazine. The central, heavily treated area remained relatively clear until Aug. 21. At that time a marked increase in density appeared in the area of high x-ray dosage surrounding the nodule, associated with a diminution in the volume of the right lung. The diagnosis of radiation fibrosis appeared definite. The patient had now become extremely weak and was critically ill. Severe dyspnea was present even at bed rest and was intensified by the slightest exertion and by frequent paroxysms of coughing. The temperature was 102°; the pulse ranged between 120 and 140, and a loud gallop rhythm was heard over the entire precordium. Death from pulmonary insufficiency and general deterioration seemed imminent (see Fig. 3).

Treatment with ACTH was started on Aug. 28, 1950, with 25 mg. every six hours. Within forty-eight hours there was dramatic improvement. The temperature returned to normal; dyspnea and cough decreased markedly; and appetite and morale became vastly improved. During the next ten days

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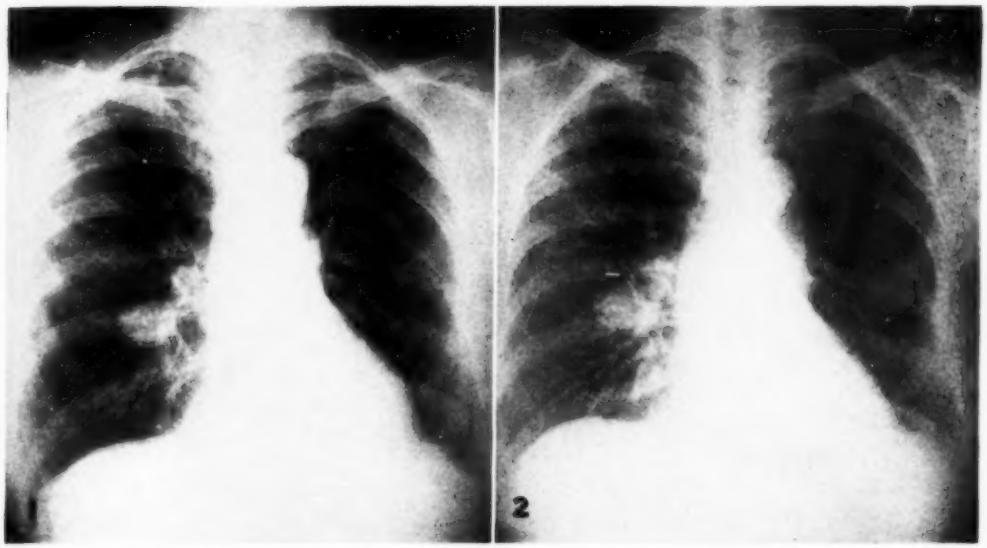

Fig. 1. Chest film, May 9, 1950. This was taken immediately before radiotherapy was begun and shows the solitary metastatic nodule in the right middle lobe, measuring 4.0 × 3.3 cm. The partially resected sixth and seventh left ribs and a small pleural adhesion in the left lateral costophrenic sulcus are the only remaining evidences of the previous left lower lobectomy.

Fig. 2. Chest film taken July 12, 1950, five days after the delivery of a tissue dose of 4,500 r in seven weeks to a sphere 8 cm. in diameter which included the metastatic nodule and right hilus. The strand-like densities in the periphery of the right upper lobe are seen. These abnormalities are well outside the heavily irradiated area surrounding the nodule and were originally believed to be due to a virus pneumonia.

there was further improvement so that the patient was able to walk about the hospital without distress. Ten days after initiation of therapy the dosage was reduced to 12.5 mg. every six hours, without decrease in the degree of improvement.

On the nineteenth day of ACTH therapy, a film of the chest confirmed the remarkable clinical improvement, showing a notable decrease in the amount of abnormal density in the superior portion of the right lung and also in the lateral peripheral portion. However, partial atelectasis of the right middle lobe was observed for the first time.

After administration of ACTH for thirty days, it was discontinued on Sept. 26, 1950 (Fig. 4), two and one-half months following the last x-ray treatment. Within twenty-four hours after stopping the drug, there was a febrile spike to 101.5°. During the next week the sedimentation rate rose from 12 to 56 mm. per hour, dyspnea and cough were slowly increasing, and there was a progressive loss of the patient's sense of well-being. However, x-ray studies of the lungs revealed no change. Because of the subjective complaints, parenteral cortisone administration was started on Oct. 3, 1950, in dosage of 300 mg. on the first day, 200 mg. on the second day, and 100 mg. daily thereafter. Improvement was slower and somewhat less in degree than following ACTH. Within four days, however, the patient was again afebrile and had experienced great improvement in her respiratory symptoms. She was discharged from the hospital on Oct. 12, 1950, and maintained on parenteral cortisone (100 mg. daily) for the following twenty-one days. For the next twenty-day period (Nov. 2 to 22) she received 200 mg. twice a week. Cortisone was discontinued on Nov. 22, 1950. No immediate symptomatic relapse followed its withdrawal.

COMMENT

Multiple small-port therapy was used in this case not only because that technic permitted the delivery of a large tumor dose, but also because a big dose could be delivered to a relatively small volume (a sphere 8 cm. in diameter). It was assumed that any radiation fibrosis which might develop would be limited to this heavily treated area.

The quantity of radiation which will cause fibrosis in the lung varies greatly in different individuals, as reported by previous authors (4–6). They all agree, however, that the possibility of fibrosis becomes greater as the dosage is increased.

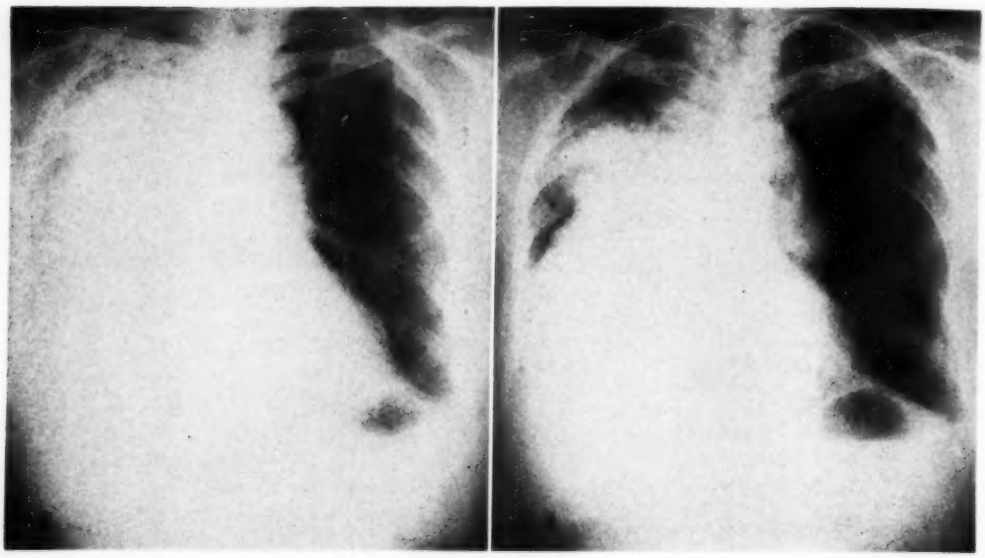

Fig. 3. Chest film of Aug. 28, 1950, forty-eight days after completion of x-ray therapy, showing abnormal density over the entire right hemithorax. On this film the most marked changes are located in the central, heavily irradiated portion as opposed to the early changes seen in Fig. 2. There is a shift of the mediastinum to the right, indicating a decrease in lung volume. The patient was extremely ill. Following this x-ray study, treatment with ACTH was instituted.

Fig. 4. Chest film taken Sept. 25, 1950, seventy-five days after the conclusion of radiotherapy and twenty-nine days after the institution of ACTH therapy. The patient was greatly improved. This film shows aeration of the periphery of the lung, though atelectasis of the right middle lobe is evident. There are probably other decreases in the right lung volume as demonstrated by the continued shift of the mediastinum and elevation of the right leaf of the diaphragm. Definite improvement is seen in comparison with the film made prior to institution of ACTH therapy (Fig. 3). The hormone was stopped on the following day.

Freid (4) believed that a large daily dosage is a more important factor than a large total dose. He also felt that treatment over the central great vessels is more apt to cause post-irradiation changes. Widmann (5) pointed out that the possibility of fibrosis is increased when the lung has been previously damaged by carcinoma, infection, arteriosclerosis, or advancing age. Warren (6) agreed that the amount of radiation alone does not determine the production of fibrosis, but he did not consider age to be a factor. Although in the present case the initial symptoms and signs, on admission, were compatible with inflammation of the lungs, they might have been due to the irradiation, which amounted to a lung tissue dose of 4,500 r in a period of seven weeks.

In any individual case the development of fibrosis is dependent on the tissue dose and volume of lung irradiated. If the treatment of a lung tumor is prescribed in terms of exposure in air without the calculation of the tumor dose, a greater tissue dose is probably delivered when the central ray of the beam or beams is directed over the great vessels in the center of the lung and a relatively large volume of lung is exposed. A much smaller amount of x-ray absorption occurs when tangential fields are used, with just the edge of the beam passing through the periphery of the lung. The dosage from the edge of the beam is low and a much smaller volume of pulmonary tissue is involved.

This patient was sixty-eight years old and was more vulnerable to the development of pulmonary insufficiency by virtue of the previous lobectomy. In an effort to protect her against the development of radiation fibrosis, dicumarol was given before and during radiotherapy, as recently described by Macht (7). Although

the prothrombin time ranged between eighteen and thirty-seven seconds (normal, fourteen seconds), dicumarol failed to prevent the ensuing severe reaction.

During the three weeks just prior to the institution of ACTH treatment, the patient was becoming progressively more ill and appeared to be in an advanced stage of pulmonary insufficiency. She showed no response to antibiotics or chemotherapy. In an effort to sustain her during this period of maximum radiation reaction in the lungs, and with the background of the previously reported experiences of Kennedy (1) and West (2), treatment with ACTH was instituted on an empirical basis.

After the patient had received ACTH for thirty days she was greatly improved both subjectively and objectively. At rest her dyspnea had disappeared and she was able to be up and walking about the hospital for three or four hours without undue fatigue. ACTH was stopped seventy-five days after the last x-ray treatment was given. At this time improvement continued beyond the period within which new changes from a course of irradiation are expected. Usually the response of tissues to irradiation from the height of the reaction to complete healing takes place within sixty to ninety days.

However, within one week following cessation of treatment with ACTH, a relapse occurred of such proportions that further treatment appeared necessary. Accordingly, cortisone was given, being continued for a total period of forty-nine days with similar, though less striking, improvement. There was no significant symptomatic relapse immediately after its withdrawal. Although the immediate post-irradiation reaction was favorably affected, the drugs did not prevent the development of fibrosis and atelectasis (Fig. 5).

The regression of the nodule was followed until the surrounding density of the radiation reaction made this impossible. Immediately before the beginning of radiotherapy, on May 9, 1950, it measured 4.0 × 3.3 cm. in the postero-anterior view. It was last identified on a comparable flash technic film of Aug. 12, 1950, when it was reduced to 3.3 × 2.5 cm. This was twenty-two days after the completion of radiotherapy and before the institution of the hormone. A heavily penetrated film made on Sept. 25, 1950, cannot be used strictly for comparison, nor can the shadow of the nodule be accurately identified. However, in the location of the original nodule a more or less discrete density is seen, measuring 2.6 × 2.4 cm.

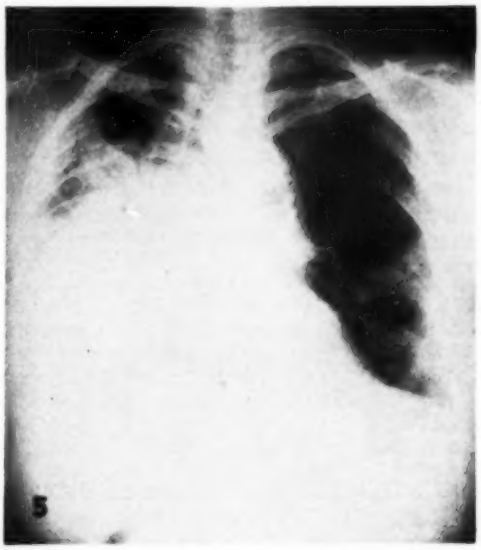

Fig. 5. Chest film of Dec. 9, 1950, five months after radiotherapy was completed and seventeen days after the hormones were discontinued. Further slight improvement has occurred as compared with Fig. 4. Clinically, the patient has a small pulmonary reserve and becomes dyspneic after a relatively small amount of exertion.

SUMMARY

A woman of 68 years was seen with a solitary metastatic nodule in the right middle lobe of the lung. By virtue of a previous lobectomy of the left lower lobe, she had a decreased pulmonary reserve when radiotherapy was instituted. She received a tissue dose of 4,500 r in seven weeks by multiple small-port therapy. Despite dicumarol prophylaxis, an extremely severe pulmonary reaction took place.

ACTH and cortisone halted and partially reversed the symptoms and signs of this severe, *acute* post-irradiation reaction. Two months after ACTH and cortisone were discontinued, late irradiation changes of atelectasis and fibrosis had appeared. There had been no recurrence of acute symptoms.

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SUMARIO

Uso de la HACT y la Cortisona en el Tratamiento de la Reacción Pulmonar Postirradiatoria

Un mujer de 68 años tenía un nódulo metastático solitario en el lóbulo medio del pulmón derecho. Por virtud de una previa lobectomía del lóbulo inferior izquierdo, había disminuído la reserva pulmonar al instituirse la radioterapia. La enferma recibió una dosis histológica de 4,500 r en siete semanas a través de varias puertas. A pesar de la profilaxis con dicumarol, tuvo lugar una reacción pulmonar de lo más grave.

A base de communicaciones anteriores acerca de los efectos favorables de la HACT en la granulomatosis y la fibrosis pulmonares, se inició la administración de dicha droga, continuándose por treinta días con notable mejoría clínica. Al suspenderse la medicación, los síntomas recurrieron y se comenzó el tratamiento con cortisona que prosiguió durante un período total de cuarenta y nueve días con efecto semejante, si bien menos notable

A los dos meses de abandonarse el tratamiento con dichas hormonas, había presentes alteraciones irradiatorias tardías en forma de atelectasia y fibrosis, sin que hubiera recurrencia de los síntomas agudos.

Olfactory Esthesioneuro-Epitheliomas[1]

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THOUGH TUMORS arising in the nasal cavity may occasionally be of neurogenic origin, this is unusual. According to a recent report from the Mayo Clinic (12) only 24 neoplasms of neurogenic origin in the nose and throat had been seen in that institution during the past twenty-seven years. The majority of nasal neurogenic tumors fall into two classes: nasal gliomas and olfactory esthesioneuro-epitheliomas.

In 1924 Berger, Luc, and Richard (2) first described a patient with a nasal tumor that histologically seemed to be composed of neural elements. Since they thought that this tumor probably arose from the sensory cells of the olfactory mucosa, they gave it the name "olfactory esthesioneuro-epithelioma." Since 1924, only 8 examples of this tumor have been reported in the French medical literature and none by American or British authors, although Stout (18) has had a personal experience with 6 cases. The nasal gliomas have been described with somewhat greater frequency, as Black and Smith (3) were able to collect 32 examples from the literature, to which they added 2 of their own. Aside from its rarity, the esthesioneuro-epithelioma is of interest because of its striking radiosensitivity, so that irradiation probably represents the preferred method of therapy.

CASE REPORT[2]

A. W., a 65-year-old white male, gave a nine-year history of trouble with his nose, beginning with nasal obstruction associated with frequent episodes of epistaxis. He consulted a physician, who discovered several large polypoid masses completely obstructing the right nasal fossa. He was admitted to a hospital where a polypectomy was performed. Histologically the excised tissue was interpreted as carcinoma. A more extensive surgical excision was recommended but was refused by the patient and he was referred for x-ray therapy. This was carried out in June 1942, 1,200 r each (measured in air) being given to a right and left lateral portal measuring 50 sq. cm., and 1,000 r to a 50 sq. cm. portal over the anterior nasal region. This was done with a 200-kv. x-ray machine, using a filtration of 1.0 mm. Al and 0.5 mm. Cu, with a half-value layer of 1 mm. Cu., at a distance of 50 cm. The treatment was fractionated into daily increments of 200 r, given over a total period of eighteen days. This resulted in the clinical disappearance of the polypoid masses in the nose and complete relief of the nasal obstruction.

Three years later the patient again began to experience anosmia and obstruction in the right naris, associated with a thick nasal and postnasal discharge, which was occasionally blood-tinged. In August 1946, following a rather profuse nasal hemorrhage he returned for further x-ray therapy. The dosage that was given during his first course of irradiation was repeated—1,200 r each (in air) to two lateral fields of 50 sq. cm. each, and 1,000 r (in air) to an anterior nasal portal of a similar size, again with apparent disappearance of nasal polypoid masses and complete symptomatic relief. This lasted for three more years, until August 1949, when nasal obstruction and episodes of epistaxis returned. Examination disclosed large polypoid masses filling the right nasal fossa, from which two large pieces were removed for biopsy. The pathologic report was as follows:

"Much of the tissue appears necrotic. Connective-tissue septa of varying widths course through the fragments of tumor. The tumor cells are uniform in appearance, with scanty cytoplasm and some hyperchromatic nuclei, which are round to irregularly ovoid. In some instances there are fine fibrillary processes which appear to extend between the cells, or in some instances to the connective-tissue septa. A review of the original slides from an outside hospital reveals thinner, somewhat more compact septa with greater cell concentration in the intervening spaces. These cells are more irregular in outline, have only slightly more cytoplasm, appear more stellate in many instances, and have more oval irregular nuclei. They also exhibit fibrillary processes between the cells. Rosettes are absent. *Diagnosis:* Neuro-epithelioma." (Fig. 1.)

Roentgenograms taken at this time revealed clouding of the ethmoids but the other sinuses were clear. There was no evidence of bone destruction. In August 1949 a third course of x-ray therapy was administered, delivering 1,300 r (in air) to two bilateral

[1] From the Department of Radiology, Washington University School of Medicine, Saint Louis, Mo. Accepted for publication in March 1951.

[2] Courtesy of Dr. A. C. Stutsman.

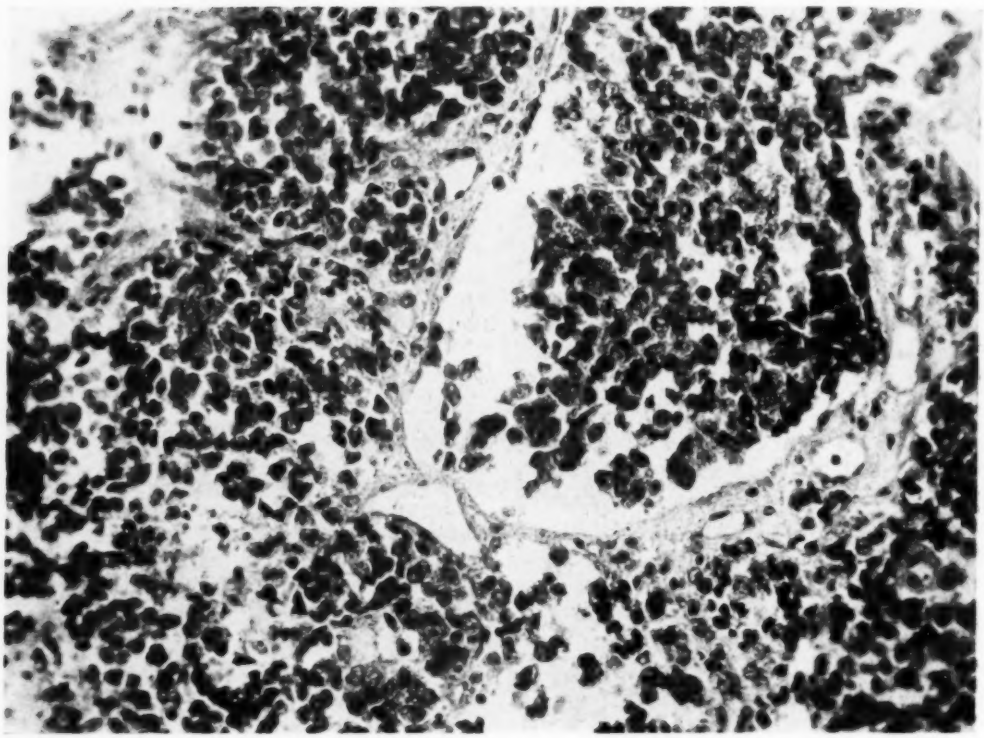

Fig. 1. Photomicrograph of the original biopsy specimen, showing undifferentiated tumor cells with homogeneous nuclei and scanty cytoplasm. No rosettes were present. × 350

fields of 100 sq. cm. each and 1,750 r (in air) to an anterior nasal portal measuring 12 by 7 cm. This again resulted in disappearance of the polypoid masses in the nose, with complete relief of symptoms.

In June 1950, the patient returned because of a non-tender mass in the right lower posterior cervical region, measuring 4 × 5 cm. He had first noticed this mass one month earlier and stated that it was increasing in size, although it was not tender or painful. Examination of the nose and pharynx at this time was negative and there was no other adenopathy. The patient was otherwise well except for postprandial epigastric distress related to a duodenal ulcer, which he had had for years. In July 1950, he was admitted to Barnes Hospital for a radical neck dissection, and at that time palpable lymph nodes were present, extending down the entire length of the right posterior cervical lymphatic chain. On July 16, a radical right neck dissection was performed by Dr. L. T. Byars, who found the entire posterior cervical chain of lymph nodes enlarged but freely movable. They spread out through the supraclavicular area on the right and extended posteriorly almost to the midline. Above the bifurcation of the carotid artery, and posterior to it, was a large mass that seemed to be invading muscle. At this point adequate removal of the growth was impossible. The gross appearance on cut section was that of a white, soft, homogeneous, multilobulated tumor. The microscopic examination revealed evidence of lymph node involvement with invasion of striated muscle. The histologic findings resembled those of the previous biopsy specimens (Fig. 2).

Because of the incomplete surgical removal of the neoplasm, postoperative x-ray therapy was instituted, 1,700 r (in air) being given to two oblique cervical portals measuring 12 × 7 cm. This was tolerated well, and when the patient was last seen there was no clinical evidence of recurrence, although it was only four months after the neck dissection. Chest films revealed no evidence of pulmonary metastases. [See Addendum, p. 546.]

PATHOLOGY

The report of Berger, Luc, and Richard in 1924 described this tumor as of two histologic types: (*a*) groups of cylindrical cells arranged around a lumen, forming typical rosettes, and (*b*) cords and sheets of undifferentiated cells with abundant cyto-

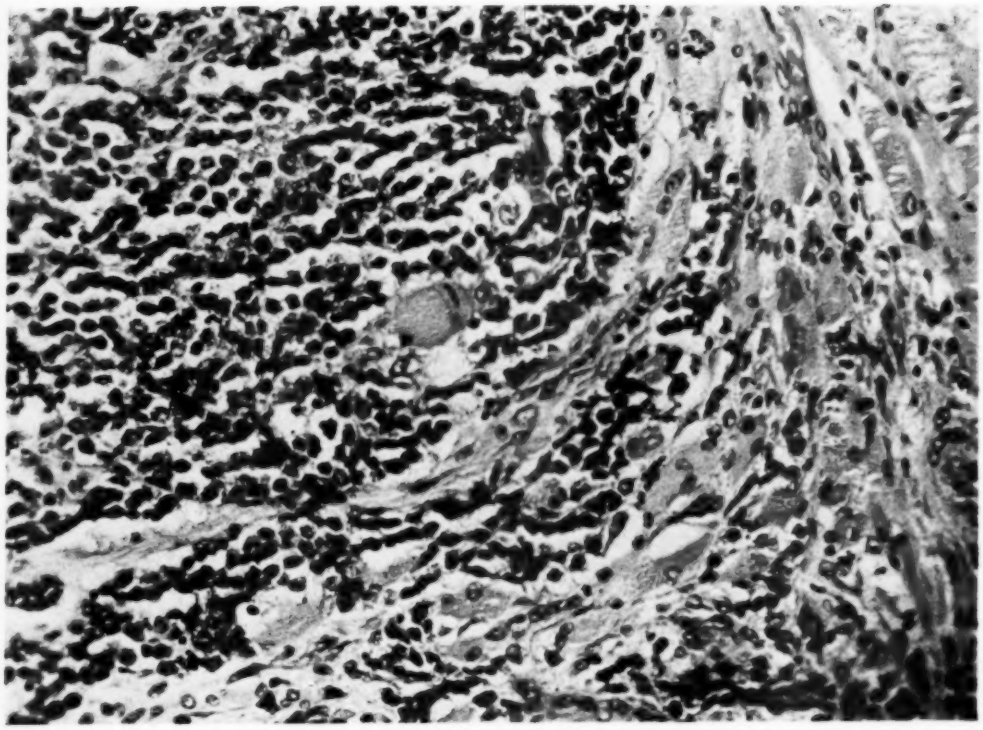

Fig. 2. Photomicrograph of tumor removed at the time of neck dissection, eight years after Fig. 1, demonstrating tumor growing out between muscle bundles. Note similarity to first biopsy specimen. × 350

plasm and indistinct cell walls reminiscent of a retinoblastoma or neuroblastoma. Mitotic figures, areas of necrosis, and abundant neurofibrils were also described. Because of the rosettes and neurofibrils, a neurogenic origin seemed most likely. In a second case, reported by Berger and Coutard in 1926 (1), the tumor contained abundant neurofibrils but no rosettes and its structure was more or less characteristic of a neuroblastoma. Because of the absence of any connection with the central nervous system, Berger considered the origin of these tumors to be the olfactory sense organ, which is unique in that its sensory cells are scattered throughout the epithelial cells of the olfactory mucosa. He thought that the cells forming the rosettes were probably supporting cells and the undifferentiated cells with the neurofibrils were primitive nerve cells of the olfactory sense organ. If both types of cells were present, he termed the growth an esthesioneuro-epithelioma, having morphological traits in common with a neuroepithelioma and a neuroblastoma; but if rosettes were absent, and the tumor was composed only of small round cells and their neurofibrils, resembling a neuroblastoma, he used the designation esthesioneurocytoma.

The sections from the case reported above were reviewed by Dr. L. V. Ackerman, who described the tumor as being composed of closely packed tumor cells with scanty cytoplasm and small homogeneous blue-staining nuclei with poorly defined nucleoli. The tumor in all of the sections appeared the same and was supported by an abundant connective-tissue stroma. There was no evidence of rosettes or reticulum being formed by the tumor cells. In the lymph nodes there was complete replacement of the architecture of the

TABLE I: ESTHESIONEURO-EPITHELIOMA. CLINICAL FEATURES OF REPORTED CASES

	Author	Age	Sex	Chief Complaint	Method of Therapy	Results of Therapy	Follow-Up
1.	Berger, Luc, and Richard (2)	50	M	Nasal obstruction	X-ray	Excellent	Six weeks, without recurrence
2.	Berger and Coutard (1)	32	F	Nasal obstruction	Surgery plus x-ray	Repeated recurrences after surgery; slight radiosensitivity	Four recurrences during a 20-year period
3.	Portmann, Bonnard, and Moreau (14)	52	M	Nasal obstruction and unilateral exophthalmos	X-ray	Excellent	None reported
4.	Massier and Duguet (11)	22	F	Exophthalmos	X-ray	Excellent	None reported
5.	Gricouroff and Dulac (7)	13	M	Nasal obstruction	X-ray	Excellent	None reported
6.	Martin, Dargent, and Gignoux (10)	14	M	Tumor in left orbito-ethmoid region	X-ray, surgery, and radium	Recurrences after surgery; none after x-ray and radium	Four years
7.	Stout (18)	...	F	.....	Surgery and x-ray	Recurrence after surgery; none after x-ray	Four years
8.	Lenz (9)	79	F	Nasal obstruction and epistaxis	X-ray	Excellent; no clinical evidence of recurrence	Fourteen months. Death from other causes
9.	Seaman	65	M	Nasal obstruction and epistaxis	X-ray	Excellent immediate result; two recurrences and metastasis to cervical nodes	Eight years
10.	Huit (8)	14	F	Nasal obstruction and epistaxis	Surgery plus x-ray	Excellent	Six years, without recurrence
11.	Rossert and Chesseboeuf (15)	8	F	...	...	...	...

node. No ganglion cells were seen. Dr. Ackerman felt that the histologic picture suggested a neuroblastoma and probably coincided with the esthesio-neurocytoma of Berger and Coutard.

CLINICAL CHARACTERISTICS

The characteristic clinical picture is that of a large, painless, polypoid intranasal mass, bleeding easily and causing progressive nasal obstruction. The age incidence in the reported cases varies from thirteen to seventy-nine years, and there is no predilection for either sex. Recurrences have been almost invariable following any type of surgical removal, while all observers comment on the striking radiosensitivity of the tumor. The case reported in this paper is the only one in which proved lymph node metastases occurred, although in the original case of Berger, Luc, and Richard enlarged submaxillary nodes were mentioned. Invasion of bone apparently does occur, but is not common and appears late in the course of the disease. Invasion of the orbit with consequent exophthalmos occurred sixteen years after the first excision in the case reported by Berger and Coutard. Massier and Duguet (11) also mentioned bone destruction in their patient.

More recently, at a meeting of the Societé de Laryngologie des Hôpitaux de Paris, Rossert and Chesseboeuf (15) described a nasal tumor in an eight-year-old girl that was suggestive of an olfactory esthesioneuro-epithelioma. Huit (8), in discussing the report, stated his experience with a fourteen-year-old girl who complained of frequent nosebleeds and nasal

obstruction, in whom a voluminous tumor was found. On microscopic examination this was said to be neuroblastoma. Treatment was by surgical excision and radiotherapy, and there was no evidence of recurrence six years later. Piquet (13) has reported a tumor of the nasopharynx which histologically resembled a neuroepithelioma and rapidly disappeared following radiotherapy. A summary of the clinical features of the cases reported in the literature is presented in Table I

RADIOSENSITIVITY

In view of the striking resemblance of this tumor histologically to the neuroblastoma, its marked radiosensitivity is not surprising. In fact, according to some, this neoplasm is a neuroblastoma arising in the nasal mucosa. Farber, in 1940 (5), was the first to point out that permanent cures could be obtained in neuroblastoma patients and recommended radiation therapy in every case. In the more recent report of Wittenborg (19) from the Boston Children's Hospital there was a 60 per cent three-year survival among patients who had incomplete surgical excision of a neuroblastoma with postoperative irradiation. This emphasizes the radiosensitivity and radiocurability of this species of tumor. Even in the presence of hepatic metastases, Wittenborg reports that 6 of 6 patients receiving only roentgen therapy survived three years without evidence of disease.

The radiocurability of the esthesioneuroepithelioma is not known, since none of the published cases had been followed for an adequate period of time. However, there is evidence suggesting that this tumor may be completely destroyed by irradiation therapy. The case of Stout and that reported by Martin, Dargent, and Gignoux (10) were free of recurrence four years following irradiation. A patient treated by Lenz (9) died fourteen months later from other causes and without clinical evidence of persisting tumor. Huit followed his patient for six years without detecting signs of recurrence. In view of the high incidence of local recurrence following surgical excision and the excellent response to irradiation, it is felt that the latter is probably the best method of therapy for this type of neoplasm.

DIFFERENTIAL DIAGNOSIS

It is important to distinguish other tumors of neurogenic origin which may be found in the nasal cavity from esthesioneuro-epithelioma, since the latter apparently is the only one which exhibits marked radiosensitivity. Intranasal gliomas were originally described by Schmidt (16), who postulated that the tumor was originally an encephalocele that had been cut off from the brain during embryonic development by closure of the embryonic sutures of the skull. According to Black and Smith (3), a study of glial tumors in the nose reveals a series of lesions varying from an encephalocele which has an ependymal-lined space filled with cerebrospinal fluid and communicating with the ventricles, to a solid mass of glial tissue entirely separate from the brain. Most of the nasal gliomas are probably not true neoplasms, since they do not show autonomous growth (3). Ganglioneuromas are extremely rare. Stout (17) described one case and cited several others from the literature. He stated that they display invasive growth but are not true malignant tumors and do not metastasize. Neurilemmomas (4) and neurofibromas may also occur in this area, and New (12) mentions a meningioma that was located beneath the skin at the root of the nose. Nasopharyngeal fibromas may extend into the nasal vestibule and produce nasal obstruction and pressure erosion of adjacent bone. Recognition is usually not difficult, because of their characteristic gross appearance and their predilection for adolescent males (6). Histologically the olfactory esthesioneuro-epithelioma could also be confused with an undifferentiated carcinoma or lymphosarcoma by one who was unaware of the entity.

SUMMARY

Observations of the course of a patient with an olfactory esthesioneuro-epitheli-

oma for over nine years are reported. The tumor exhibited marked radiosensitivity, although it later metastasized to the cervical lymph nodes. Similar cases collected from the literature are briefly reviewed. Because of the high recurrence rate following local excision and the striking response of the tumor to irradiation, it is felt that roentgen therapy is the treatment of choice.

NOTE: The author is indebted to Dr. L. V. Ackerman for helpful criticisms and suggestions and for reviewing the histological sections.

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ADDENDUM: The patient returned on Sept. 15, 1951, complaining of dyspnea, orthopnea, and dysphagia. Chest roentgenograms disclosed an extensive mediastinal tumefaction and bilateral pleural effusions, and roentgen therapy was begun to these areas.

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SUMARIO

Estesioneuroepiteliomas Olfatorios

Las observaciones presentadas abarcan la evolución durante nueve años de un enfermo con estesioneuroepitelioma olfatorio. El tumor manifestó pronunciada radiosensibilidad, aunque luego metastatizó en los ganglios linfáticos cervicales. Repásanse sucintamente casos semejantes recogidos de la literatura. Debido al elevado índice of recurrencias consecutivamente a la excisión local y a la notable respuesta del tumor a la irradiación, parece que la roentgenoterapia es el tratamiento de elección.

Es importante diferenciar del estesioneuroepitelioma otros tumores neurógenos que pueden encontrarse en la cavidad nasal, dado que el primero es al parecer el único decididamente radiosensible.

Chondroangiopathia Calcarea seu Punctata

Review and Case Report[1]

EARL R. HAYNES, M.D., and WM. F. WANGNER, M.D.

THE PRENATAL recognition of developmental abnormalities is now a fundamental of diagnostic radiology. Within the past two years we have seen the same mother bear two successive fetuses showing anomalies of development. In each instance roentgen studies prior to delivery revealed the presence of an abnormal fetation. In February 1949, routine antepartum studies showed bony maldevelopment of the fetus and the mother was subsequently delivered of a stillborn achondroplastic dwarf which, in addition, was a typical cyclops monster. Twenty-one months later a second pregnancy was investigated by means of roentgenograms and a similar skeletal malformation with an interesting variant was noted.

Chondroangiopathia calcarea seu punctata was originally described from pathological material by Langhans in 1893, and the first roentgen studies of a case were reported by Conradi in 1914. The essential feature of the disease is the presence of stippled foci of calcification within the hyaline cartilage in the fetal stage or during early infancy. Many names have been applied to this embryological disorder, as chondrodystrophia congenita calcificans, chondrodysplasia congenita calcificans, chondroangiopathia calcarea congenita, stippled epiphyses, punctate epiphyseal dysplasia, and chondrodystrophia punctata. Selection of the designation "chondroangiopathia calcarea seu punctata" is in conformity with Cocchi's nomenclature in Schinz' new *Lehrbuch der Röntgendiagnostik*. The term "punctata" adequately describes the radiological characteristics and "chondroangiopathia" is descriptive of the abnormally coursing blood vessels and cartilage columns as seen histologically.

The infrequent appearance of this disease places it among the group of rare developmental anomalies. The reports in the literature indicate that it is a familial condition, although the exact nature of the disturbance is unknown. Syphilis has not been demonstrated to be a factor. Inasmuch as both parents and children have shown stigmata, the influence of prenatal injury is unlikely. Apparently the calcifications within the cartilage originate sometime in later intra-uterine life, are present at birth, and are frequently first diagnosed during early infancy. Although the disease may be an isolated entity, it is at times associated with complete or partial dwarfism, such as brachydactylism, shortened femora, or achondroplasia foetalis.

According to Cocchi, there is a disturbance in the vascularization of the epiphyseal cartilage and of the cartilaginous anlage of the small bones of the extremities. The cartilaginous columns show degrees of divergence from their usual parallel arrangement. The calcium deposits as a nidus about the terminal portion of the abnormally disposed vessels. Whether the primary anomaly is within the blood vessels or the vessels are merely parallel to the abnormally coursing cartilage columns is not known. In the instance reported here, it would seem that the calcific deposits were concomitant with the abnormally directed cartilage columns rather than the result of vascular pathology.

CASE REPORT

L. S., a 24-year-old white woman, was examined in February 1949 in the sixth month of gestation. The pregnancy had progressed normally except for a moderate amount of ankle edema and frequent headaches. No evidence of hypertension was noted during the prenatal observations. The patient's serology was negative and the Rh blood typing was positive. Poor co-operation prevented a study of the family tree of either parent in regard to congenital anomalies.

[1] From the Henry Ford Hospital, Detroit, Mich. Accepted for publication in March 1951.

Fig. 1. Roentgenogram taken in first pregnancy, which terminated in the delivery of a stillborn cyclops monster of achondroplastic type. Note the unusual splayed position of the extremities. The film suggests but does not conclusively demonstrate punctate calcific deposits in the epiphyses.

Roentgenograms revealed normal maternal pelvic measurements. The fetus was average in size for the end of the second trimester. The long bones of the extremities were uniformly shortened, with relative broadening and flaring of the diaphyseal ends. The position of the extremities was bizarre, midway between flexion and extension, resembling the posture of a swimming frog, and the spine was without the normal flexion of the fetus *in utero* (Fig. 1). A uniform haziness over the uterus suggested polyhydramnios. The roentgen diagnosis was fetal death accompanied by abnormal skeletal development, probably chondrodystrophy. On Feb. 7, 1949, a cyclops monster was delivered in a macerated state, showing typical features of achondroplasia foetalis. Postpartum photographic and x-ray studies could not be obtained. The mother's postpartum course was uneventful.

In November 1950, the patient was again seen for obstetrical survey. Roentgen examination revealed a third trimester pregnancy with the fetus in normal universal flexion. Although the films were not diagnostic for details of the long bones of the extremities, the arms and legs appeared relatively shortened; the over-all physical size of the fetus was average for a pregnancy at term. The patient was admitted on Dec. 17, 1950, and after twelve hours of labor was delivered by breech extraction, with forceps on the aftercoming head. The placenta was normal in appearance and was expelled spontaneously.

The infant died after three hours, during which time the extremities were continuously cyanotic, and the respirations were labored, with intercostal and suprasternal notch retraction. The cyanosis progressed and death ensued from anoxia. Autopsy was not permitted.

Grossly the infant presented the typical physical attributes of an achondroplastic dwarf, namely, a large cranial vault, saddle nose, frontal bossing,

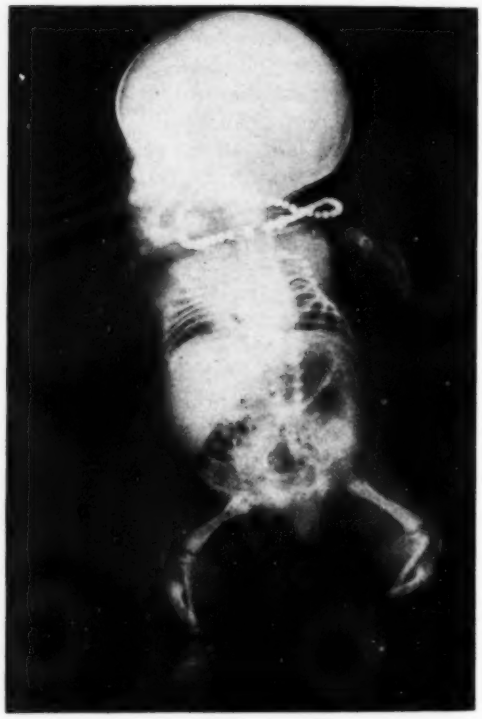

Fig. 2. Postpartum roentgenogram of second fetus, showing universal distribution of epiphyseal stippling.

shortened skull base, trunk of average size, protuberant abdomen, and symmetrically shortened extremities. A large scrotal hernia was an incidental finding.

Radiographic studies generally paralleled the gross appearance, with all of the above features clearly demonstrated. The foreshortened long bones with flaring of the metaphyses combine with these findings to present a pathognomonic picture of achondroplasia foetalis.

The striking feature of the radiographs was the presence of spotty calcific densities occupying the areas of the vertebral epiphyses, the epiphyses of the long bones of the extremities, and the short tubular bones of the hands and feet (Figs. 2 and 3). Close examination revealed the normal epiphyseal centers of all long bones and vertebrae (Fig. 4) to be uni-

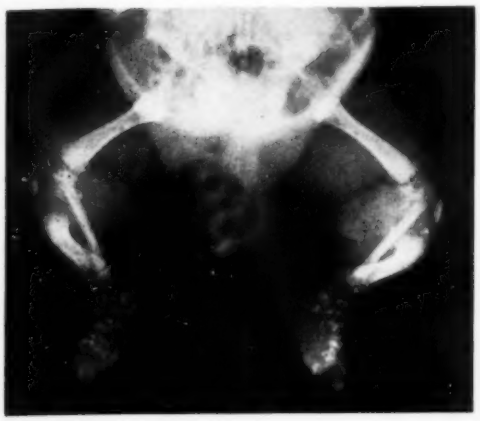

Fig. 3. Details of disorderly calcific deposition in epiphyses of the lower extremities. Note the herniated gas-filled loops of bowel in the scrotum.

formly replaced by this stippled calcific process. The hyoid ossification centers were similarly replaced, and a small amount of irregular calcification was present in the hyaline cartilage of the larynx.

DISCUSSION

The differential diagnosis of chondroangiopathia calcarea seu punctata is not difficult. The roentgen demonstration of multiple calcific densities throughout the cartilaginous system in a newborn infant is virtually pathognomonic. Stippled epiphyses are also described in association with hypothyroidism, in which situation the term cretinoid epiphyseal dysgenesis is applied. This condition, however, occurs later in life, usually from the second year onward; it has a less universal distribution, and the individual foci tend to be larger. Multiple foci of ossification within an epiphysis as a normal variant should cause no confusion, since they are limited to a few epiphyses and tend to be few in number and smooth in contour.

Chondroangiopathic stippling does heal. In the early phase the bone ends may superficially resemble aseptic necrosis. The completely healed phase has been said to be represented by linear striae of increased density (Voorhoeve stripes) running from the epiphyseal plate into the metaphysis.

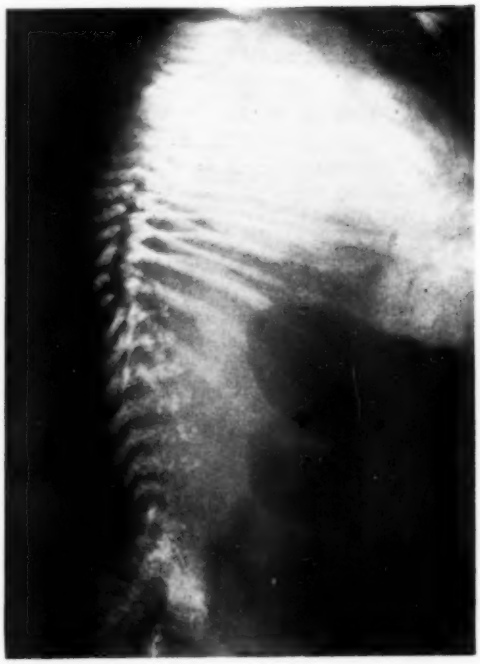

Fig. 4. Lateral view of spine, showing replacement of normal vertebral epiphyses by spotty calcific densities.

SUMMARY

A case of chondroangiopathia calcarea seu punctata present at birth, in association with achondroplasia foetalis, is described. The patient was the sibling of a previously stillborn achondroplastic dwarf.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Chondroangiopathia Calcarea seu Punctata. Reseña e Historia Clínica

El caso descrito es de chondroangiopathia calcarea seu punctata congénita y asociada a acondroplasia fetal. El enfermito era el hermano menor de un enano acondroplásico nacido muerto.

La enfermedad es conocida también con otros varios nombres, incluso condrodistrofia calcificante congénita, epífisis granuladas y condrodistrofia punteada. La característica esencial es la presencia de focos punteados de calcificación dentro del cartílago hialino ya en la etapa fetal o la infancia temprana. El hallazgo roentgenológico de muchas condensaciones calcificadas por todo el sistema cartilaginoso en un recién nacido es patognomónico.

Clinical and Roentgen Observations of a Newly Perforated Peptic Ulcer[1]

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IN THE LAST SEVEN and a half years, 699 patients have been discharged from the Pennsylvania Hospital with a diagnosis of peptic ulcer. Eighty-five, or 12.7 per cent of this number, showed clinical evidence of perforation. This percentage, it must be remembered, is based upon a specific group admitted to a hospital and does not represent the incidence of perforation in all cases. While it is thus apparent that perforation is not an uncommon complication of ulcer, its demonstration during the course of a barium study has only rarely been reported.

In the following case perforation occurred following fluoroscopy, while the patient was awaiting further examination, and unusually early roentgenograms were thus obtainable.

CASE REPORT

A 59-year-old man, seen in November 1950, gave a history of symptoms beginning the preceding June, with a gradual increase in "nervous tension." He had lost 10 pounds in weight in the past three months, apparently related to a decrease in appetite.

His past medical history was non-contributory, and in a systemic review the only positive finding was the occurrence of occasional attacks of indigestion. He was considered a psychiatric problem because of his emotional background in relation to several weighty personal problems and had been treated for "nervous spasms" by his local physician. It was accepted that he had functional disease, and a routine upper gastro-intestinal examination was ordered to rule out an organic lesion.

Fluoroscopically, the stomach was negative; the duodenal cap was large and irregular, with a niche on the lesser curvature side. It showed irritability and was tender to normal palpation. After completion of the initial part of the examination, the patient, in an apparently normal state and while awaiting further filming for motility studies, suddenly experienced acute pain in the right upper quadrant of the abdomen, approximately one-half hour after the ingestion of the barium meal, associated with rigidity of a moderate degree. While being examined, he voluntarily complained of right shoulder pain. A clinical diagnosis of perforated peptic ulcer was made.

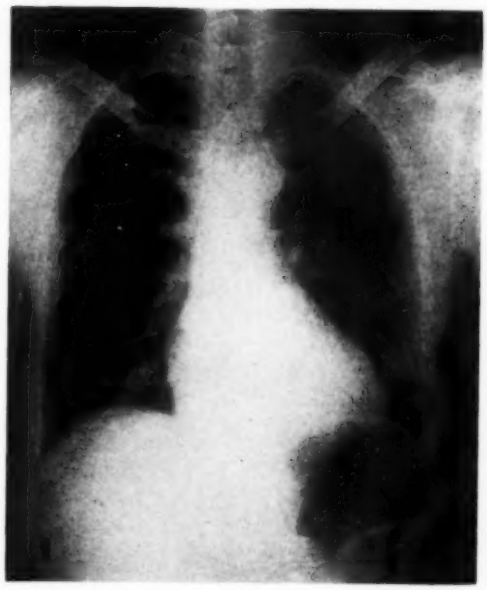

Fig. 1. Roentgenogram of chest obtained fifteen minutes after onset of symptoms.

Two films were taken in the ensuing thirty minutes, before the patient was admitted to the hospital. Fifteen minutes after the onset of the sharp pain, an upright film of the chest was obtained to demonstrate air under the diaphragm. No evidence of free air in the peritoneal cavity was found (Fig. 1). Thirty minutes after the onset of symptoms, a scout film of the abdomen showed a very thin streak of barium outside the intestinal tract (Fig. 2), proving the clinical diagnosis.

In approximately one and one-half hours, all the classical signs of perforation had developed, including loss of liver dullness and abdominal rigidity.

Less than three hours after the original symptoms, films were made in the erect and horizontal positions before the patient was sent to the operating room.

[1] From the Department of Radiology, Pennsylvania Hospital, Philadelphia, Penna. Accepted for publication in January 1951.

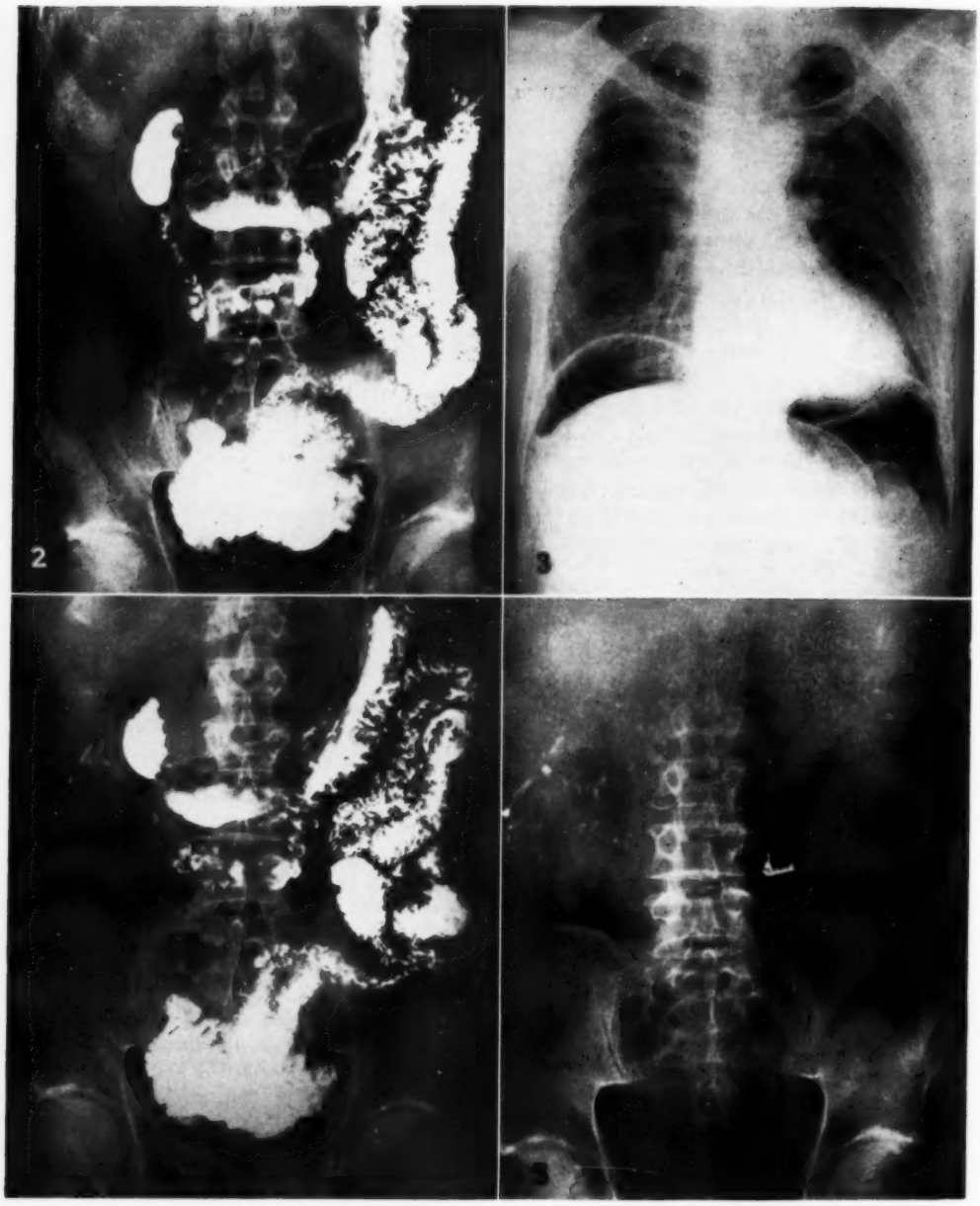

Fig. 2. Original roentgenogram of abdomen, showing a small streak of barium in the peritoneal cavity.
Fig. 3. Roentgenogram of chest obtained less than three hours after onset of symptoms. Extensive pneumoperitoneum.
Fig. 4. Scout film of abdomen taken less than three hours after onset of symptoms, showing additional barium in the peritoneal cavity.
Fig. 5 Residual barium in the peritoneal cavity two weeks postoperatively.

The upright film (Fig. 3) showed an unusually large amount of free air in the peritoneal cavity, while the air in the stomach was considerably less than on the previous film. The scout film of the abdomen (Fig. 4) showed an increase in the amount of barium free in the peritoneal cavity.

At operation a perforation measuring approximately 3 mm. in diameter was found on the anterior duodenal wall and a scum of barium was seen coating several adjacent loops of small bowel. There was no free puddling of the barium.

Figure 5 shows the residual barium in the peritoneal cavity two weeks postoperatively.

We believe that perforation in this instance was spontaneous, as no pressure device or abnormal manual palpation was used in an effort to bring out the mucosal pattern.

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SUMARIO

Observaciones Clínicas y Roentgenológicas de Ulcera Péptica Recién Perforada

En el caso de úlcera duodenal perforada aquí descrito con ilustraciones, fué posible obtener radiografías en término de treinta minutos de la perforación. La roentgenoscopia había revelados signos de la úlcera, y el enfermo estaba aguardando nuevos estudios cuando de repente experimentó un intenso dolor acompañado de rigidez en el hipocondrio derecho. En término de hora y media habían hecho acto de presencia todos los signos clásicos de perforación. Se reproducen las radiografías tomadas a los quince y treinta minutos y a unas tres horas de la iniciación del dolor. La operación demostró que la perforación quedaba en la pared anterior del duodeno. Una radiografía ejecutada dos semanas después de la intervención muestra bario residual en la cavidad peritoneal.

La perforación parece haber sido espontánea, pues no se aplicó presión anormal para acentuar el patrón de la mucosa.

Fictitious Pelvic Mass[1]

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THE various organs of the gastro-intestinal tract may at times cast an unusual shadow resembling a soft-tissue mass which is ovoid in appearance. This shadow appears when the "hollow organ" is contracted with no contents, and is presented on the roentgenogram in tangential projection. When these two conditions prevail, any portion of the gastro-intestinal tract may be visualized as an ovoid soft-tissue density.

Nathanson demonstrated that the cardiac end of the stomach in the supine position may present such an appearance. A similar ovoid density may be observed in the left pelvic region, representing the contracted sigmoid caught tangentially.

This density has often been misinterpreted by clinicians as a pelvic mass of undetermined character, and even a negative barium enema may leave them unconvinced. In the case illustrated here (Figs. 1 and 2) a scout film of the abdomen showed an ovoid left pelvic density, which persisted in subsequent intravenous urograms up to the thirty-minute exposure. At that time gas appeared in the center of the shadow, proving it to be intestinal.

Although the cardiac end of the stomach and the sigmoid are the most common locations for the appearance of a fictitious mass, any part of the gastro-intestinal tract may give a similar shadow, provided it be contracted and be projected tangentially. This may be the explanation of elusive masses often observed on abdominal, and especially urological, roentgen examination.

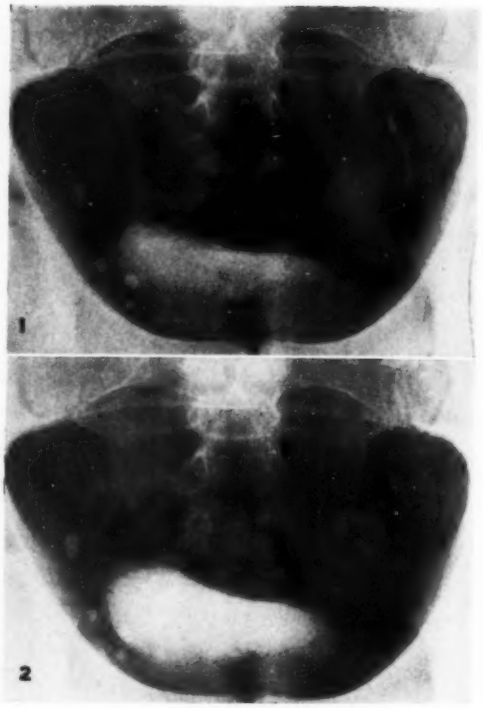

Fig. 1. A fifteen-minute exposure during intravenous urography, showing an ovoid left pelvic density of almost the same consistency as the urinary bladder, which contains dye.

Fig. 2. Thirty-minute exposure. Gas is seen within the ovoid density, which is evidently sigmoid colon.

121 East 60th St.
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REFERENCE

NATHANSON, L.: Shadow of the Cardiac End of the Stomach Simulating a Soft Tissue Tumefaction in the Supine Position. Radiology **32:** 473–475, April 1939.

[1] Accepted for publication in February 1951.

SUMARIO

Falsa Tumefacción Pelviana

Al contraerse cualquier parte del tracto gastrointestinal, puede visualizarse roentgenográficamente, en proyección tangencial, como una condensación ovoidea de tejido blando y ser confundida por el clínico con una tumefacción pelviana. Esto reza en particular con el extremo cardíaco del estómago y la S ilíaca. En el caso descrito con grabados el descubrimiento de gas en el centro de la imagen a los treinta minutos, estableció que se trataba de una S ilíaca contraída.

The Johns Hopkins Fluoroscopic Screen Intensifier[1]

RUSSELL H. MORGAN, M.D., and RALPH E. STURM

IN RECENT YEARS, considerable attention has been focused upon our need for brighter fluoroscopic screens. It has been pointed out that the clarity of fluoroscopic vision should be improved many times, that the need for dark adaptation before fluoroscopy should be eliminated, and that the radiation dosage delivered to the patient and radiologist during fluoroscopy should be reduced if brighter screens were available to us.

A few years ago work was begun in at least three laboratories in this country to develop devices by which fluoroscopic screens may be brightened or intensified. Coltman (1) at the Westinghouse laboratories in East Pittsburgh undertook investigations which have recently culminated in the development of an electronic image tube capable of intensifying the fluoroscopic screen approximately one hundred and fifty times. A short time later, Moon (2), at the University of Chicago, began work directed toward the development of a screen intensifier based on the "flying spot" system used in television. Although practical results have not yet been achieved, Moon (3) anticipates large gains in screen brightness with this system.

Early in 1948, studies in screen intensification were undertaken at the Johns Hopkins Hospital. Our first research was concerned with investigation of the fundamental physical and physiological factors influencing fluoroscopic vision (4). Work was then begun on the development of a screen intensifier which, we hoped, would yield gains in screen brightness of 1,000 times or more. This instrument has just been completed and placed under test in our laboratory. It has not been described heretofore.

Fig. 1. Johns Hopkins fluoroscopic screen intensifier.

CONSTRUCTIONAL DETAILS

The complete intensifier, arranged for clinical study, is illustrated in Figure 1. It comprises three principal units: (*a*) a conventional fluoroscopic x-ray generator operating at kilovoltages ranging from 70 to 100 kv.p. and at a tube current of 5 ma.; (*b*) an x-ray image detector; (*c*) a fluoroscopic viewing unit. The principles upon which these three units operate together may be visualized in Figure 2. The x-rays produced by the fluoroscopic generator, *A*, pass through the anatomical structure under examination, *B*, and enter the x-ray

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[1] From the Department of Radiology, The Johns Hopkins University and Hospital, Baltimore, Md. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

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image detector unit. Within this unit, the radiation first passes through a stationary wafer grid, *C*, and then impinges upon a fluorescent screen of a conventional zinc sulfide type, *D*. The images appearing on the fluorescent screen are then focused on the sensitive surface of an image orthicon, *G*, by a folded Schmidt optical system consisting of three plane mirrors, *M*, a corrector plate, *P*, and a spherical mirror, *F*.

It will be observed from the preceding description that the intensifier combines the optical principles of photofluorography with the engineering principles of television. Such a combination permits considerable flexibility in the design and operation of the instrument. The size of the field of examination, for example, need not be inconveniently small, as in the case of screen intensifiers of the image-tube type, but instead may approach the size of conventional fluoroscopes through proper design of the optical system. Furthermore, the inclusion of contrast controls in the amplifier circuits permits one to increase the relatively low contrast levels characteristic of fluoroscopy to contrast levels more nearly in line with those seen in x-ray films. A considerable improvement in the clarity of image reproduction may thereby be obtained. Also, the circuits may be arranged

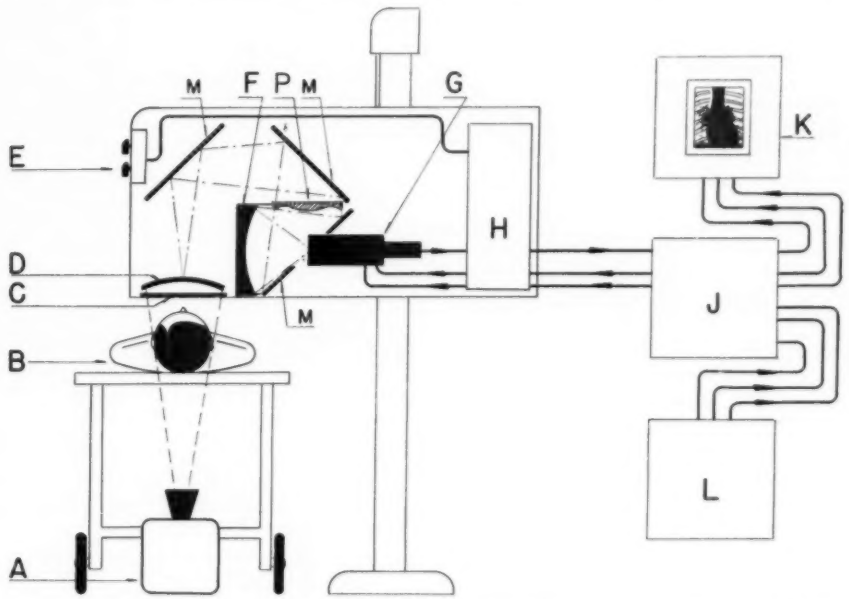

Fig. 2. Schematic diagram of the Johns Hopkins fluoroscopic screen intensifier. A. Fluoroscopic x-ray generator. B. Patient under examination. C. Wafer grid. D. Fluoroscopic screen. E. Intensifier controls. M. Plane mirrors. P. Corrector plate of Schmidt optical system. F. Spherical mirror of Schmidt optical system. G. Image orthicon. H. Preamplifier. J. Final amplifier. K. Viewing unit. L. Pulse former for generating electrical pulses which sweep the electron beams of the image orthicon and kinescope in synchrony with one another.

The image orthicon, an electronic tube used in many television cameras, converts the fluorescent images into an electric current which is amplified many times, first by a preamplifier, *H*, and after that by a final amplifier, *J*. Finally, the amplified current is applied to a television viewing tube or kinescope, *K*, where it produces on the viewing surface of the tube a brightened or intensified reproduction of the anatomical structure being examined. A pulse-forming unit, *L*, is also included in the apparatus to provide triggering pulses for sweeping the electron beams within the image orthicon and the kinescope.

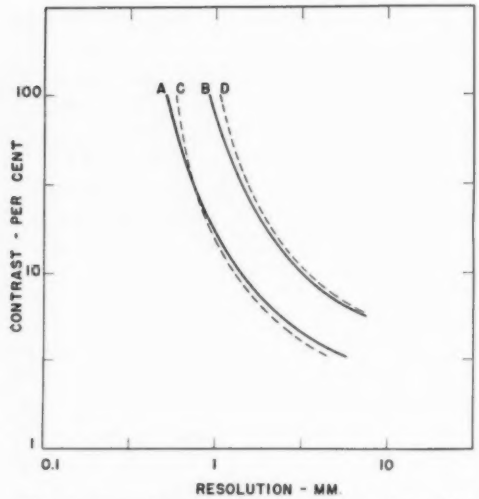

Fig. 3. Experimental visual performance data of the Johns Hopkins screen intensifier (curves A and B) and of conventional fluoroscopy (curves C and D). Curves A and C refer to conditions equivalent to those occurring during the examination of the chest; curves B and D refer to conditions equivalent to those occurring during the examination of the abdomen in the anteroposterior projection. Tube voltage, 70 kv.p.; tube current, 5 ma.; tube-screen distance, 27 inches; viewing distance for fluoroscopy, 20 cm.; screen used in fluoroscopy, Patterson B-2.

to include a phasing switch with which the images recorded on the viewing screen may be made to appear either in their positive form, as they normally occur on conventional fluoroscopic screens, or in their negative form, as they normally appear in x-ray films. Such an arrangement allows the radiologist to select the type of image rendition that is most satisfactory to him.

PERFORMANCE CHARACTERISTICS

In chest fluoroscopy, the brightness levels yielded by the screen intensifier are approximately 300 to 1,000 times greater than those provided by conventional fluoroscopes; in abdominal fluoroscopy, the gains are of the order of 1,000 to 3,000 times. Such intensifications bring the level of screen illumination to approximately 3 foot-lamberts during the examination of both the chest and abdomen. Since this level of illumination is well within the range in which cone vision is used, no dark adaptation is needed prior to the use of the intensifier.

The resolution or clarity of reproduction of the instrument is shown graphically in Figure 3. Here the minimum object size (diameter) discernible with the device is plotted as a function of object contrast for chest fluoroscopy in curve A and for abdominal fluoroscopy in curve B. The resolution curves for conventional fluoroscopes under similar conditions are plotted respectively in curves C and D. Objects having a size and contrast to the right and above each curve may be seen by an observer; objects having a size and contrast to the left and below each curve are not visible. It will be observed that the resolution of the screen intensifier under most circumstances is only slightly greater than that of conventional fluoroscopes. To some, such a performance may seem disappointing. It must be pointed out, however, that conventional fluoroscopy in actual practice seldom approaches the perfection illustrated in Figure 3; indeed, the data shown in curves C and D are only valid when the radiologist follows a sixty-minute period of dark adaptation and adopts a viewing distance of 20 cm. As a result, most observers when viewing the screen intensifier have a feeling that its clarity is reasonably satisfactory.

In its present form, the resolution of the screen intensifier falls considerably short of the limits which seem possible on theoretical grounds (4). This is hardly surprising, for it was extremely unlikely that the ultimate limits of resolution would be achieved in the first intensifier to be constructed. Now that satisfactory gains in screen brightness have been attained, future efforts will be directed toward improvements in screen clarity. Experimental studies now in progress make it appear that these improvements will be forthcoming.

Although we have designed our intensifier for experimentation in standard fluoroscopic technics, there are two other applications where we believe the instrument may prove useful. First, it seems rather easy to make x-ray motion pictures directly from the kinescopic screen. These films, unlike

Fig. 4. Projection kinescope for demonstration of fluoroscopy to large audiences.

those made under more conventional cineroentgenographic conditions, may be exposed with the x-ray generator operating at normal fluoroscopic kilovoltages and tube currents. Hence, one may make x-ray motion pictures covering a period of several minutes rather than a period of a few seconds, as has been the case in the past. In the making of x-ray motion pictures directly from the kinescopic screen, it is of course necessary to synchronize the motion picture camera with the operation of both the x-ray generator and the screen intensifier. Such synchronization constitutes a relatively simple engineering problem, which has been overcome in practice with little difficulty.

Another characteristic of the intensifier which we believe is of some value is the ease with which the amplified current may be applied to a kinescope of the projection type. Such a kinescope projects its images on a screen similar to that used for the projection of lantern slides. The fluoroscopic patterns, therefore, may be viewed by several persons rather than by a few. With such a projection kinescope, it appears feasible to teach fluoroscopy to medical students and physicians with a facility that has not heretofore been possible.

The projection kinescope which we are currently using is shown in Figure 4. As will be seen from the size of the screen, the projected images cover a field 3×4 feet. The images are almost as bright as those produced by a conventional slide projector. They therefore can be viewed without dark adaptation by the persons observing the screen. The clarity of reproduction possible with the projection kinescope seems almost as good as that seen on the standard kinescope of the screen intensifier. For example, the details of pulsating vascular structures within the chest can be easily seen by a group of twenty-five or thirty medical students seated before the screen.

DISCUSSION

It should not be concluded from the pre-

ceding discussion that screen intensification methods are now ready for widespread clinical application. Although many who have witnessed our unit in operation believe that its performance is spectacular, we should like to point out that the intensifier in its present form is too bulky and complicated for the convenience of most radiologists. Simplification in circuitry and the development of more sensitive image orthicons must now be undertaken to insure the satisfactory operation of the instrument in the hands of the practising radiologist. When these developments will take place cannot be predicted. We believe it is significant, however, that the first steps toward practical screen intensification have now been taken and the results appear quite gratifying.

It is too early yet to determine the effect which screen intensification methods will have on the practice of radiology. It appears, however, that intensification systems, even after they become practical clinical tools, will be limited by their relatively high cost to use in the larger institutions of the country. It also appears that screen intensifiers will supplement rather than replace the diagnostic apparatus which we now have. There seems to be no reason to believe that intensification systems will revolutionize radiology; instead, it is likely that they will merely contribute to the steady evolution which has long been taking place.

SUMMARY

A system for intensifying or brightening the fluoroscopic screen from 300 to 3,000 times has been developed at the Johns Hopkins Hospital. The instrument, employing the principles of photofluorography and of television, has seen use in limited clinical trials. It has also been employed in cineradiography and in the teaching of medical students. In the latter application, a projection kinescope has been used to throw the intensified fluoroscopic images on a large screen, which may be readily seen by many observers.

ACKNOWLEDGMENTS: The writers wish to acknowledge the very considerable assistance given them in the development of the screen intensifier described in the foregoing paragraphs by Drs. G. A. Morton and Robert Janes of the R. C. A. Laboratories in Princeton, N. J., and Lancaster, Penna.; by Dr. Brian O'Brien of the University of Rochester, Rochester, N. Y.; and by Dr. W. H. Bylers of the U. S. Radium Corporation, New York City.

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4. STURM, R. E., AND MORGAN, R. H.: Screen Intensification Systems and Their Limitations. Am. J. Roentgenol. **62:** 617–634, 1949.

SUMARIO

El Intensificador Johns Hopkins de las Pantallas Fluoroscópicas

Utilizando los principios de la fotorroentgenografía y la televisión, en el Hospital Johns Hopkins, han elaborado un sistema para intensificar o abrillantar de 300 a 3,000 veces más la pantalla roentgenoscópica. Comprende el mismo tres aparatos principales: (*a*) generador corriente de rayos X para roentgenoscopia, funcionando con kilovoltajes de 70 a 100 kv.p. y con una corriente de 5 ma. en el tubo; (*b*) revelador de la imagen radioscópica; (*c*) aparato para ver la roentgenoscopia.

El aparato ha sido empleado en limitadas pruebas clínicas. También ha sido utilizado en cinerradiografía y para la enseñanza de los estudiantes de medicina. En esta ultima aplicación, se ha usado un kinescopio de proyección para lanzar las intensificadas imágenes fluoroscópicas sobre una pantalla grande, que pueden ver fácilmente a la vez muchos observadores.

The Effect of Single Massive Doses of Roentgen Radiation Upon the Liver

An Experimental Study

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THE EFFECTS of radiation upon the liver have been extensively investigated, but contradictory findings are reported. This study presents an analysis of the acute morphologic alterations which may occur in the rabbit's liver following single massive doses of roentgen radiation to that organ. Doses of 300 to 100,000 r were given and the animals were sacrificed or succumbed at various intervals thereafter.

Observations on the histopathologic changes in the liver following roentgen irradiation have been made by several workers. Hall and Whipple (3), Martin and Rogers (6), Warren and Whipple (13–16), have reported absence of histologic change in the liver following deep roentgen therapy. Pohle and Bunting (9) described an alteration after doses of 600 to 2,500 r, manifested by an initial swelling of the hepatic cells with subsequent atrophy following recovery. They believed the swelling to be due to an imbibition of serum and occasionally of fat.

Case and Warthin (1) described three human cases in which there was extensive damage to the liver following intensive irradiation for malignant disease. They expressed the belief that the medium-sized and small bile ducts are sensitive, as shown by vacuolization, swelling, and necrosis of the epithelial cells followed by a slow and atypical regeneration attended by the formation of syncytial giant cells blocking the ducts, with consequent bile stasis and hemorrhage. Some injury to the liver cells was noted, essentially at the periphery of the lobules.

Hartoch and Israelski (4) studied the effects of 1,000 to 4,000 r (180 kv., 1.0 mm. Al and 2.0 mm. Cu filter) on summer frogs. With a fluorescent microscope, they observed an actual shrinkage of the bile capillaries following high dosages. Lüdin (5) reported evidence of nuclear damage in the livers of rabbits receiving large doses of filtered radiation. Smythe and Whipple (11), by means of bile fistula experiments, demonstrated rapid recovery from the liver damage resulting from irradiation. Doub, Bolliger, and Hartman (2) observed that following fractional doses of irradiation to dogs some animals showed a reduction of 50 per cent in the weight of the liver, extensive fatty infiltration, areas of focal necrosis, some increase of fibrous tissue at the periphery of the lobule, loss of the orderly cell arrangement, and extensive regeneration.

Reports have also been presented describing the effect of intravenously injected thorium dioxide upon the liver. Pohle and Ritchie (10) noted hydropic degeneration, edema of the portal spaces, and dilatation of the periportal lymphatics, with subsequent slight atrophy of liver cells and fibrosis of portal spaces. Similar reports have been made by Orr *et al.* (7) and by Patoir and Bedrine (8).

The contradictory observations on the histologic alterations of the liver resulting from roentgen irradiation are probably due to differences in dosage and in the type of radiation administered. Because of the marked regenerative ability of this organ, damage must be quite severe before it is manifested morphologically. Doub *et al.* expressed this concept in the statement that the liver is one of the most susceptible organs to acute destruction, and one of the most resistant to permanent damage.

METHOD

In this study large doses of radiation were administered to enhance and intensify

[1] Accepted for publication in March 1951.

the production of definite morphologic alteration. Ninety-six normal adult (young) New Zealand white stock rabbits were used for experiments. The skin area in contact with the cone was painted with gentian violet to indicate the path of the radiation beam into the deep structure. With high dosage and after several days, the area of liver irradiated showed in some cases gross changes clearly demarcated from the adjacent parenchyma. In other cases, where no gross effect was demonstrable, the area beneath the gentian violet marker was used for histological study. Occasional errors in choice of samples may have resulted under these circumstances. In all instances where the animals did not succumb, they were sacrificed by injection of air into the ear vein and autopsied immediately. Samples from representative portions of the liver were fixed in Zenker's formalin solution and stained with eosin and hematoxylin. In some instances segments were fixed in formalin for fat stains.

Of the 96 animals studied, 7 received 300 r; 23 received 3,000 r; 43 received 30,000 r; 12 received 50,000 r; 4 received 100,000 r; and 7 were given 3,000 r over the lower abdomen with the liver shielded to determine if any alterations occur in the liver following irradiation of the intestines.

It may be mentioned that various and marked differences exist in the histologic appearance of liver from apparently normal, healthy stock animals kept under constant conditions. Differences in glycogen content, size of cells, proportion of liver cells to extracellular space, to mention a few of the more common visible variations, are common. In view of these normal differences, only marked changes in the sections studied were attributed to irradiation; alterations of a minor nature were not considered abnormal.

If, at autopsy, any gross abnormality was observed that was not due to irradiation, such as focal infection or cysts, the animal was discarded.

RADIATION TECHNIC

The radiation used in this experiment was generated by a four-valve generator operating at 90 kv.p and 35 ma. Machlett CYR tubes were water-cooled by drilling the anodes and running tap water through the drilled portion. No additional filtration was added to the inherent filtration of the glass wall, which was equivalent to 0.2 mm. Al. The peak kilovoltage was checked by the use of a Seeman spectograph, and the minimum wave length was kept close to 0.138 Angstrom units. The effective wave length of the radiation delivered to the surface of the animals was 0.240 Angstrom units. Measurements of the absorption in the rabbit's skin and liver, both *in vivo* and in freshly removed tissue, showed very little difference. About 30 per cent of the radiation was absorbed in the skin, and an average of 38 per cent of the dose delivered to the skin surface was delivered to the center of the liver. Absorption curves showed that 1 cm. of liver tissue was approximately equal to 1 mm of Al.

RESULTS

300 r Series

Seven rabbits received 300 r over the liver. Three were sacrificed two days afterward, 2 three days afterward, and 2 seven days following the irradiation.

The essential finding in all of these animals was a slight separation of the liver cords, probably representing a mild hepatic edema. It was most marked in the central portions of the lobule, near the central vein and in the vicinity of the larger vessels. Pale-staining eosinophilic amorphous material was observed within the spaces between the liver cords in many areas. It appeared to be somewhat more abundant three days following irradiation. In the rabbits sacrificed at seven days the edema had practically subsided. In addition, the liver segments presented engorgement of the smaller vessels, most pronounced near the periphery of the sections. This was not noted in the rabbits sacrificed two days following irradiation.

The control farthest removed from the

radiation beam presented an identical histologic appearance to those areas directly in the beam. No unusual findings were observed in the hepatic cells, biliary ducts, or blood vessels.

Comment: The essential alterations in the liver following 300 r were a mild extracellular hepatic edema and mild engorgement of the smaller vessels. The changes were most marked three days following irradiation, and had almost completely disappeared at seven days. The entire organ showed this alteration, both the segment of the liver directly in the x-ray beam and the portions at a distance from the direct path of the radiation.

3,000 r Series

Twenty-three rabbits received 3,000 r, with the factors described above, and were sacrificed at various intervals from immediately following irradiation to seven days afterward.

1. Immediately following irradiation (3 rabbits): The liver sections revealed nothing unusual.

2. Twelve hours after irradiation (3 rabbits): A characteristic finding in all sections was a marked infiltration of polymorphonuclear leukocytes, particularly in the portal areas. These cells were extremely abundant between the connective-tissue elements of the portal areas and were seen also among the epithelial cells of the bile ducts. Most of the portal areas showed this acute inflammatory cellular infiltration except in one instance (A185). Small clumps of polymorphonuclears were seen in the parenchyma adjacent to the portal area or in other sections of the liver, with no observable relationship to the liver components. Some areas showed a diffuse infiltration of polymorphonuclear elements; there was an increase in the size and number of the fibroblasts and of large mononuclear-like cells. Many vessels were dilated and engorged. One section revealed hemorrhage into the portal space (A186).

In the non-irradiated control areas the polymorphonuclear leukocytic infiltration was not present, except to a minimal degree. Some vessels were engorged.

3. One day after 3,000 r (4 rabbits): The essential alteration in all sections from animals sacrificed one day after a dose of 3,000 r was a separation of the liver cords, presumably due to hepatic edema. In the spaces between the cords was a pale-staining eosinophilic debris. All sections (irradiated and non-irradiated control) showed extracellular edema to a moderate degree. The edema of non-irradiated control areas was less than that of the irradiated areas. The edema was most marked in the central portion of the lobule; at times none was demonstrable in the peripheral portion. The liver was otherwise normal. Very slight polymorphonuclear leukocytic infiltration was noted.

4. Two days after 3,000 r (3 rabbits): The essential finding in this group was an extracellular edema, but of a much less degree than one day after 3,000 r. The edema was for the most part central.

5. Three days after 3,000 r (3 rabbits): There was a slight degree of edema three days after a dose of 3,000 r. In one section (A192) there was a small area, the size of a high-power field, where dissolution of liver substance had occurred with autolysis of the liver cords (noted as pale-staining eosinophilic cords) with degenerated necrotic, finely granular, chromatin-staining material, and a few polymorphonuclears. Large mononuclear cells were present in the periphery. No such degeneration was noted in the non-irradiated control areas.

6. Seven days after 3,000 r (7 rabbits): Sections from animals sacrificed seven days after receiving 3,000 r appeared essentially normal. There was a slight amount of edema, and slight engorgement of some of the small vessels and sinusoids. Few polymorphonuclear cells were seen in the vicinity of the portal areas. No necrosis was observed.

Comment on 3,000 r: No immediate effect was manifested morphologically. Twelve hours after irradiation with 3,000 r there was a marked infiltration of polymorphonuclear leukocytes, essentially in

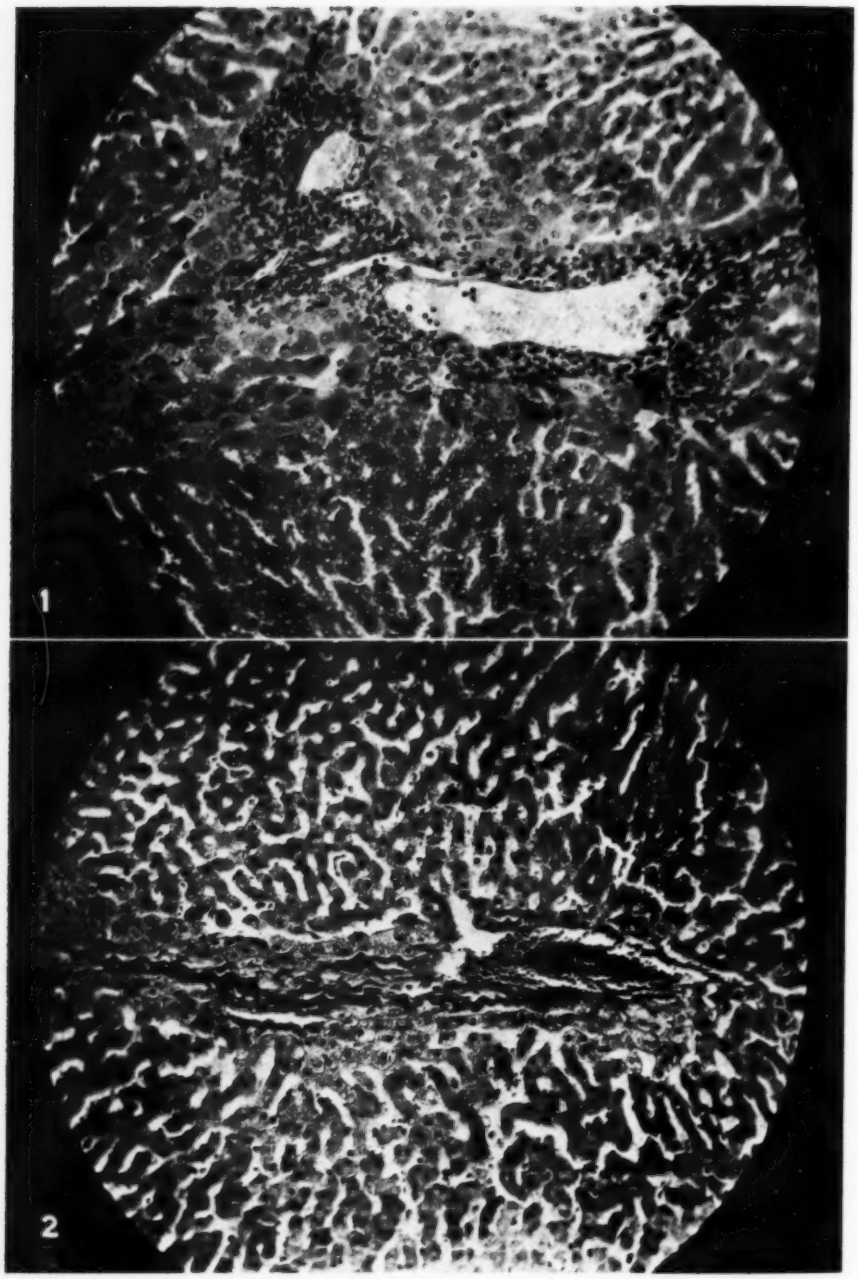

Fig. 1. Polymorphonuclear leukocyte infiltration twelve hours after 3,000 r.
Fig. 2. Separation of liver cords one day after 3,000 r.

the portal spaces and to a lesser extent diffusely scattered about in the hepatic sinusoids. No such infiltration was seen in the non-irradiated control areas of the same liver. The acute cellular infiltration appeared to be transitory, with but few of the cells remaining three days and seven days following irradiation.

A slight degree of cellular edema was noted after twelve hours, becoming most marked one day following the irradiation (of 4 rabbits studied, 3 showed marked edema and 1 mild edema). The edema was most severe in the central portion of the lobule but, when present in a marked degree, was evenly distributed throughout the entire section of liver studied. In milder forms of disturbance, only that portion of liver adjacent to the central vein was edematous and the peripheral portion was normal.

In the one-day series following 3,000 r, non-irradiated control areas showed relatively severe edema, but it was not quite so extensive as that in the irradiated areas. There was a gradual diminution of the edema two days after irradiation, and only a minimal amount remained after seven days. Congestion of the hepatic vessels and to a lesser extent of the sinusoids was observed in all sections from twelve hours to seven days. A significant finding was a small area of dissolution of liver parenchyma in one section with remnants of liver cells as pale-staining eosinophilic cords, with finely granular chromatin-staining material (probably fragmented remnants of nuclei) and a few polymorphonuclear cells within. This degenerated area occupied a space about the size usually occupied by 8 liver cells and in all probability represents the histopathological unit of liver damage by irradiation. The absence of any such degenerated areas seven days following 3,000 r is suggestive of complete recovery at this period.

Hemorrhage into a portal area in one animal two days after 3,000 r suggests damage to the endothelium of the vessel. No definite lesions were noted in any of the vessels studied.

30,000 r Series (43 rabbits)

1. Immediately after irradiation (5 animals): In all sections engorgement of the small vessels in the field of irradiation was seen. All 5 irradiated liver sections showed a minimal amount of extracellular edema. In 2 animals there was a small amount of polymorphonuclear leukocytic infiltration. The polymorphonuclears were diffusely scattered over the sections, being located particularly in the stroma of the periportal areas, as shown in sections taken in the twelve-hour series after 3,000 r.

The non-irradiated control section of the liver showed a slight polymorphonuclear infiltration and more glycogen vacuolization than was noted in the irradiated areas.

2. Twelve hours after 30,000 r (7 animals): At twelve hours edema was a prominent feature and there was a polymorphonuclear leukocytic infiltration to a somewhat greater extent than was noted in those sections taken immediately after 30,000 r. All cells stained more faintly. In several of the sections there was moderate engorgement of the smaller vessels. No marked difference was observed between the irradiated and the non-irradiated control areas, the latter showing the same changes but to a lesser extent.

3. One day after 30,000 r (7 rabbits): The histologic findings in this series were very similar to those noted twelve hours after 30,000 r. There were a variable amount of edema and engorgement and a small amount of polymorphonuclear infiltration.

4. Two days after 30,000 r (6 rabbits): Marked edema was present throughout most sections. There was polymorphonuclear leukocytic infiltration into some of the portal areas, and congestion of the smaller vessels and the sinusoids was prevalent. The characteristic feature of this series was a small necrotic patch. The patches were diffusely scattered about the section and varied in size from small areas containing about 12 leukocytes to large ones about twice the size of the high-power field. There was no relationship between the location of the necrotic patch and the

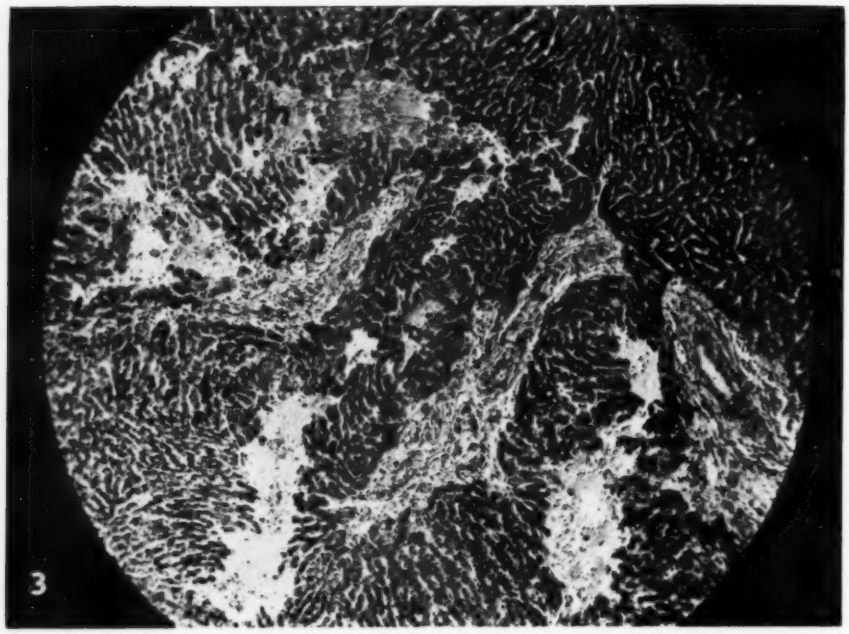

Fig. 3. Small necrotic patches scattered about the section, two days after 30,000 r.

position of the liver lobule (whether central or peripheral). The necrotic patch consisted of faintly staining hyaline-like skeleton liver cords enclosing degenerated chromatin-staining amorphous particles. Nuclei were occasionally seen within the necrotic areas in various stages of fragmentation. In several, there was no indication of nuclei. The necrotic patch contained a variable number of polymorphonuclear leukocytes and red blood cells. The hepatic cells along the margin of the patch appeared entirely normal, and the demarcation between the normal and the degenerated cells was sharp and well defined. No gradation in change from normal to destroyed liver cells could be discerned. In several sections the necrotic patches were enlarged and had apparently coalesced. Two animals did not show any patchy necrosis, 1 showed an occasional small necrotic patch, and in 3 the patches were large and numerous. Fibroblasts in some of these areas appeared unaffected, while in others they not infrequently were seen as round to elongated, enlarged cells.

5. Three days after 30,000 r (8 rabbits): Several of the irradiated sections revealed edema of such extent as to appear to compress the cells, which were much smaller than ordinarily observed. Small and large necrotic patches were noted. In a large necrotic patch the liver cells appeared as hyaline-like, amorphous cords with a very faint hematoxylin shell of the nucleus apparent. The spaces between the cords were crowded with polymorphonuclear leukocytes, some appearing normal and some in various stages of degeneration. In other areas the necrotic part consisted of amorphous debris with no discernible relationship to the previous architecture. Three of the 8 animals showed necrotic patches scattered throughout the section.

Sections including the non-irradiated areas all showed severe edema and engorgement of the smaller vessels, and to a lesser extent of the sinusoids, with red blood cells.

6. Seven days following 30,000 r: There was gross destruction of liver parenchyma. Large areas containing necrotic degener-

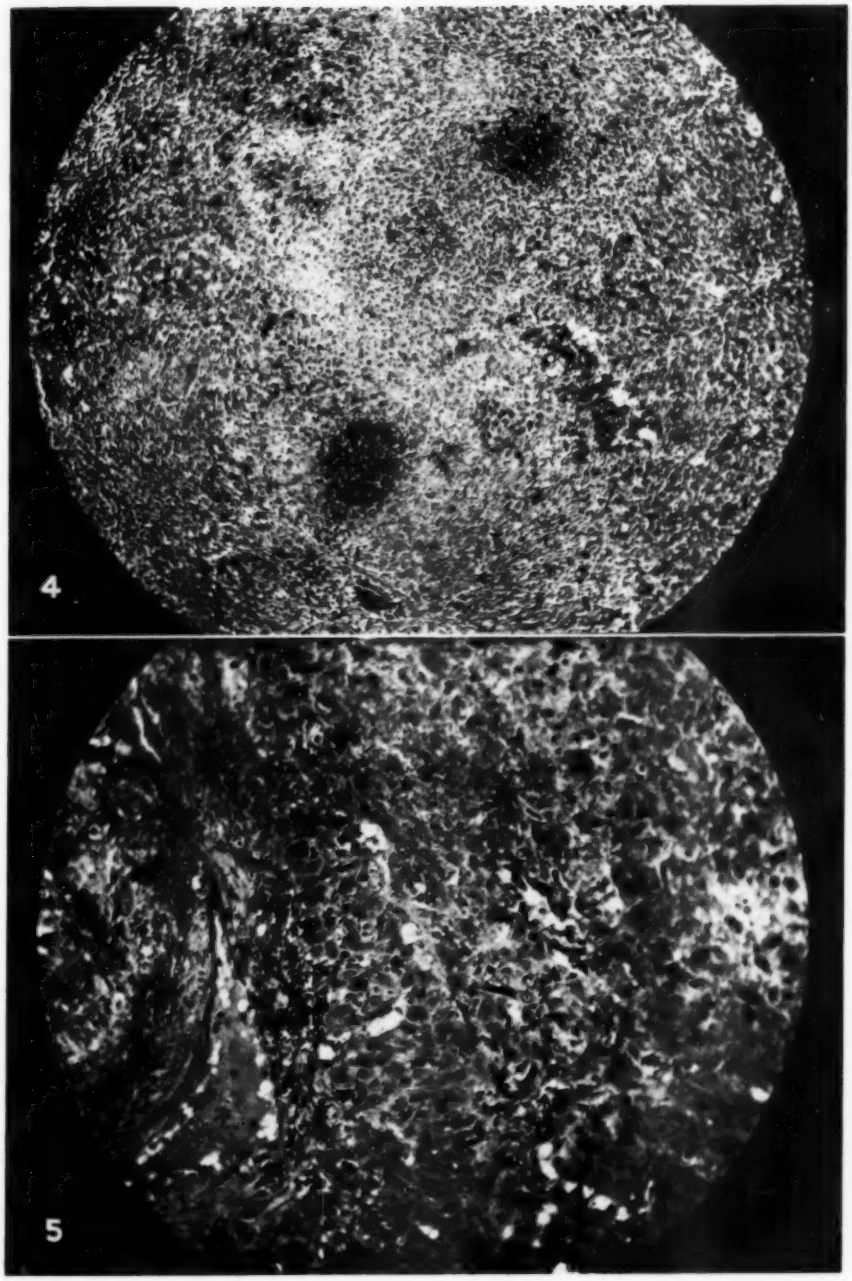

Fig. 4. Coalescing of necrotic areas, three days after 30,000 r.
Fig. 5. Appearance of liver cells—hyaline and amorphous with hyperchromatism—three days after 30,000 r.

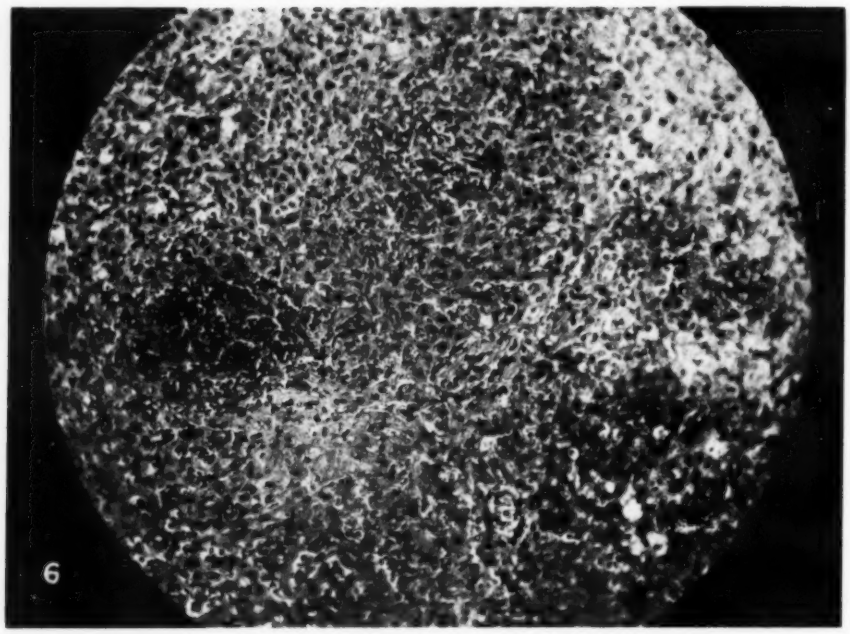

Fig. 6. Marked necrosis of liver cells, seven days after 30,000 r.

ated liver debris were noted. There were marked extravasation of red blood cells and separation of the fibrous tissue elements. The non-irradiated control appeared essentially normal.

The histologic picture of the irradiated portion varied. Some sections showed apparently normal liver tissue, with slight edema and red blood cell infiltration. Others showed necrosis, varying from very small degenerated patches consisting of shells of hepatic cells with occasional polymorphonuclear leukocytes within, surrounded by normal looking parenchyma, to widespread necrotic areas with debris throughout a greater portion of the section. The liver cells that were viable did not present any observable histologic alteration. Edema, at times to a marked extent, and engorgement of red blood cells of the smaller vessels and the sinusoids were common features of this series. Polymorphonuclear infiltration throughout the section was observed in one instance. Occasionally in both the three-day and seven-day series following 30,000 r the infiltration of polymorphonuclear cells among the bile ducts was accompanied by a swelling of the epithelium of the smaller and medium-sized ducts. The swollen cells occasionally were seen to obstruct the lumen of the duct. In a few instances they appeared to be degenerating and sloughing from the wall into the lumen. A significant finding was an apparent hyperplasia of the cells of the duct with the formation of syncytial giant cells.

7. Twenty days following 30,000 r (3 rabbits): Three animals were sacrificed twenty days following a dose of 30,000 r, and no evidence of morphologic alteration was observed. This may be interpreted as representing complete repair following irradiation damage of an unknown extent.

Comment on 30,000 r Series: The 30,000 r series was characterized by edema and congestion. The edema was present immediately following administration of 30,000 r and gradually increased in intensity until the third day, at which time it was so abundant as to cause increased volume of the extracellular spaces with a correspond-

ing compression of the hepatic cells. Less edema was noted after seven days than after three days. Congestion and engorgement of the smaller vessels and sinusoids were present throughout.

Polymorphonuclear leukocytic infiltration was a characteristic finding in this series. It was noted immediately following irradiation and in increased amount at twelve hours. The intensity of the polymorphonuclear reaction appeared to remain constant from twelve hours to two days and then to decrease. At three days and seven days following irradiation, it was not very pronounced.

Necrosis of the liver parenchyma was observed two days after irradiation. Of the 6 animals studied, 2 did not show necrosis, 1 showed small necrotic patches, and 3 large necrotic patches diffusely scattered throughout the sections studied. The necrosis was somewhat greater in amount after three days than after two days.

Sections from the seven-day series varied from those which were apparently normal to others where destruction of liver parenchyma was marked and widespread. Why the liver remains essentially normal in some animals and in others shows severe destruction is not clear.

To review briefly the histologic alteration following 30,000 r: During the first two days there were gradually increasing edema and polymorphonuclear infiltration, especially in the portal areas and to a lesser extent diffusely scattered throughout the sinusoids. A certain amount of this type of change was present in the non-irradiated portions of the liver, but necrosis was not observed at any time. The first appearance of hepatic destruction was manifest the second day following irradiation, and the degree and amount of destruction gradually increased during the period studied (seven days). Repair seemed to be complete in twenty days.

50,000 r Series (12 rabbits)

1. Immediately after 50,000 r (3 rabbits): Marked congestion in the sinusoids, severe edema, and some periportal and diffuse, acute, inflammatory, cellular reaction was seen in these 3 animals.

2. Two days after 50,000 r (1 rabbit): Slight edema and congestion were present. Bile ducts showed degeneration of epithelial cells and much amorphous necrotic debris in the lumina. Patchy areas of necrosis were observed throughout.

3. Three days after 50,000 r (5 rabbits): Large necrotic areas were prevalent throughout all irradiated sections, with complete destruction of liver parenchyma in large areas. The viable portions of the liver appeared as large sheets of liver cells arranged serpiginously about the degenerated areas. The central portions of many of the smaller degenerated areas were filled with polymorphonuclear leukocytes and many degenerated polymorphonuclears and their debris. In these areas an occasional shell of a liver cell might be discerned, but they were extremely few. The outer border of the necrotic patch was devoid of polymorphonuclear cells, consisting almost entirely of liver cell skeletons, or of faintly eosinophilic, pale-staining areas, still maintaining a semblance to the liver cord. Elsewhere there was an intermingling of the degenerated liver cords and the polymorphonuclear cells.

Fat stains revealed large quantities of fatty infiltration within the degenerated areas but very little within the viable hepatic cells. The gross and histologic demarcation between the completely necrotic and normal cells was quite sharp. There was an intermediary zone of congestion and hemorrhage in which many normal liver cells were noted, but the others were in a degenerated form.

Degeneration and abnormal regeneration of the bile duct epithelium were noted, with formation of syncytial giant cells and much debris and many polymorphonuclears in the duct lumen.

4. Seven days after 50,000 r (3 rabbits): Grossly the liver showed a well defined loss of substance in the lobe beneath the irradiated area. Here the tissue was a yellowish red in color and pulpy in consistency. Histologic sections showed it to

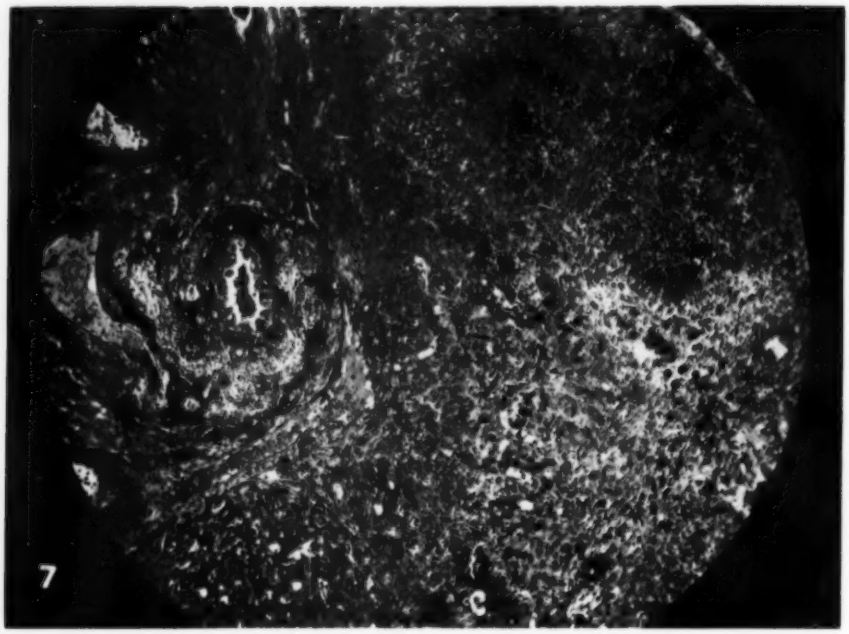

Fig. 7. Diffuse areas of necrosis, three days after 50,000 r.

consist of amorphous, necrotic debris, with only an occasional liver cell identifiable. The cords were dim shadows, and the bile ducts were necrotic. Hemorrhage was present around many of the visible blood vessels. The structure had collapsed to about one-half its previous size. The non-irradiated portion was apparently normal.

Comment on 50,000 r Series: Severe congestion and periportal acute inflammatory cellular reaction were noted immediately following irradiation. Two and three days later there were patchy necrotic areas diffusely scattered throughout the liver section in the beam of radiation. Large areas of liver parenchyma were destroyed, with small groups or layers of viable, normal-looking liver cells around the degenerated areas. If the viable cells were damaged there was no histologic manifestation of this.

In the degenerated areas, blood vessels were fragmented and serum and red blood cells surrounded them in large quantities. The bile duct epithelium was swollen, and in many sections polymorphonuclear cells were seen among the bile duct epithelial cells. Frequently granular debris and normal-appearing and fragmented polymorphonuclear leukocytes were present within the bile ducts. By the end of seven days there was complete destruction of the liver parenchyma in the irradiated zone, with no definite abnormality in the non-irradiated part.

100,000 r Series (4 rabbits)

1. Immediately following 100,000 r (1 rabbit): The cells were pale-staining, and the orderly arrangement of the hepatic cords was disturbed. There were marked congestion and an infiltration of polymorphonuclear leukocytes.

2. One and one-half and two and one-half days following 100,000 r (3 rabbits): Numerous small and large necrotic areas were present throughout the irradiated region, with many large areas showing evidence of complete destruction of the liver structure. The lesions were identical with those observed in the 50,000 r series, but were more extensive.

One liver studied two days after irradiation with 100,000 r showed small patchy necrotic areas throughout the entire section, even outside the beam. In another, about half of the right lobe was a completely necrotic mass but the remainder of the liver (non-irradiated) was essentially normal. The radiation in this case apparently struck the right half of the right lobe. The rabbits did not tolerate these enormous dosages; death occurred not infrequently by the end of the exposure period; other animals survived for a few days.

Changes Following 3,000 r to the Lower Abdomen

Seven animals were irradiated over the lower intestine, in an attempt to determine if the damage to the intestinal epithelium, with an ensuing intoxication as described by Warren and Whipple (15), might have an effect on the morphology of the liver as suggested by Hall and Whipple (3). At autopsy the intestines were hyperemic and showed necrosis of the epithelium, but the microscopic appearance of the liver in all instances was normal.

DISCUSSION

That irradiation produces marked morphologic alterations in the liver was emphasized by Wetzel (19), who reported necrosis of the left lobe of the liver in a patient receiving irradiation for carcinoma of the stomach. Warthin (17) described atrophy, chronic passive congestion, and slight parenchymatous degeneration in livers of human beings receiving roentgen therapy for leukemia, but he did not consider the lesions to be of importance, nor their severity to be wholly attributable to irradiation. He did not note any pathologic changes in the livers of animals which he irradiated. Lüdin (5) described lesions in rabbit and guinea-pig livers that were exposed to irradiation, consisting essentially of fatty degeneration and hyperemia. Tsuzuki (12) irradiated rabbits with high-voltage irradiation and reported hyperemia and degeneration of the liver cells, with almost complete repair within thirty-six to forty-eight hours; in animals that received lethal doses, atrophy was noted in the liver. Case and Warthin (1) presented 3 cases of liver damage in patients with irradiation sickness. The damage was localized essentially to the epithelium of the small bile ducts, and there was slight degeneration of the liver cells in the periphery of the lobule. Hall and Whipple (3) found no constant microscopic or gross alteration in the parenchymatous organs following irradiation over the abdomen, but they mentioned "focal hyaline necrosis" in several of their dogs, which they interpreted as representing focal bacterial necrosis as a result of bacteremia following severe damage to the intestine.

It becomes apparent in this series that the response to irradiation varies greatly in different animals of the same species receiving equal doses. The reason for this is not evident. The functional state of the organ at the time of irradiation may possibly play a role.

Following doses of 300 r, there was a mild edema throughout the entire liver, which was most marked three days following the irradiation and had practically disappeared by the seventh day. There was also slight congestion of the smaller vessels.

In the rabbits receiving 3,000 r to the liver, no immediate change was observed histologically. Twelve hours after irradiation there was a transitory, acute inflammatory cellular infiltration, particularly abundant in the portal areas and, to a lesser degree, diffusely scattered throughout the sinusoids. This cellular reaction was of a transitory nature and had almost completely disappeared after one day, though it did persist to a slight degree for the seven days of observation.

Slight congestion of the smaller vessels was observed in most of the sections studied. Extracellular edema was first apparent twelve hours after 3,000 r, reaching a peak one day afterward and persisting for the seven days of observation. It was first apparent in the central portion of the lobule and to a lesser degree in the periphery.

Small necrotic areas were occasionally noted three days following 3,000 r; their absence seven days following irradiation suggests complete healing by regeneration of liver cells. The small area of dissolution of the liver parenchyma may represent the histopathological unit of hepatic destruction, consisting of a small group of hepatic cells destroyed from the radiation effect. The scattering of these necrotic foci suggests a localization of radiosensitivity at various points of the liver instead of a homogeneous effect from the irradiation beam. The destroyed areas had a pale eosinophilic hyaline-like appearance, consisting of liver cell shadows, enclosing fragmented nuclei and nuclear debris. Polymorphonuclear cells then invaded the area and fragmented polymorphonuclear cells could be seen in addition to normal polymorphonuclears. The absence of such areas seven days following 3,000 r suggests that the debris has been cleared away, with regeneration of the neighboring hepatic cells to replace the destroyed area. One section showed a fibrous tissue reaction in the degenerated area.

Although the hepatic cells surrounding the necrotic patch appeared normal, evidence has been presented that functional alterations take place in the liver before any morphologic changes are observed. Smythe and Whipple (11), in bile fistula experiments, demonstrated an initial decrease in liver function followed by a rapid return to normal. Czepa and Högler (20), using various hepatic functional tests, demonstrated deranged hepatic function following deep irradiation to the abdomen, which they believe contributes to irradiation sickness.

In this laboratory (unpublished data) it has been demonstrated that there is an increase in cellular water following 300–3,000 r and 30,000 r before there is any morphological manifestation of hepatic cell injury. It is believed by several authors (Failla 21; Ewing, 22; and Pohle, 10) that such an increase results in morphologic alteration. Hence it is conceivable that many normal-appearing cells in the area are damaged to an unknown extent and the mechanism for their disruption is functioning but has not yet caused the disintegration of the cell. Unless the organism can overcome the damage (of an unknown nature but consisting of one observed alteration, that is, increase in cellular water) the cell dies.

In the 3,000 r series small necrotic patches showed that small clumps of cells had been destroyed but that most of the liver parenchyma was morphologically normal. Absence of necrosis seven days afterward indicated recovery, with regeneration and repair in the necrotic areas.

In the series of animals receiving 30,000 r, evidence of cellular necrosis was present two days following irradiation, and the amount and degree of degenerated areas gradually increased during the period of the study (seven days). This would suggest damage to a larger number of cells to the extent where recovery was not possible. Although no evidence of degeneration was observed until the second day following irradiation, functional changes not manifested morphologically occurred, resulting in the death of a greater number of cells with increased lapse of time. The extent to which this destruction would develop, and whether or not the repair might be accompanied by hyperplasia of the hepatic cells or be associated with a marked fibrous tissue reaction, is not known.

It is noted that, although some animals showed marked histopathologic alterations at various intervals following 30,000 r, others presented an apparently normal liver with variable amounts of edema and congestion. The reason for this is not obvious, but it may represent an increased resistance of the liver due to some inherent functional state at the particular time that radiation was administered, or the beam may not have struck the liver throughout the irradiation period even though particular care was taken to avoid this mischance.

In 3 animals sacrificed twenty days after 30,000 r, the absence of histologic change may represent either complete repair following some degree of damage or it may be

that in those livers no changes occurred. It is not possible to determine which of these two alternatives is correct.

With greater doses (50,000 r, and 100,000 r), large areas of liver were destroyed. Grossly some of the livers presented a definite zone of light brown, homogeneous tissue, soft in consistency and sharply demarcated from the surrounding liver parenchyma by a hemorrhagic border. This necrotic-like tissue extended for a variable depth into the liver and even penetrated to the inferior surface. In other instances the liver presented numerous areas, varying from 0.5 to 3.0 cm. in diameter, discolored a yellowish-brown and drab brown. These areas were scattered profusely over the entire liver, and involved all the lobes. Histopathologically they were noted as localized liver degeneration. Large areas of complete hepatic destruction were also observed in which few viable liver cells occurred predominantly about the central vein. Since most of the glycogen stored in the rabbit liver seems to be in the cells of the central portion of the lobule, it is conceivable that the glycogen content may have a sparing action.

The large areas of necrosis consisted of skeletons of many lobules which appeared as pale eosinophilic hyaline-like cords through which was scattered amorphous, chromatin-staining nuclear debris (suggesting destruction of nuclei by karyolysis). Diffusely scattered through these necrotic areas were large numbers of polynuclear leukocytes, many apparently in various stages of destruction. In some areas where destruction was not so marked, fibroblasts were seen as elongated elliptical cells. Extravasation of red blood cells was frequently observed throughout the necrotic areas. The extravasated red cells were most abundant at the junction of the necrotic areas and the normal parenchyma.

Numerous variations in hepatic cells not in the necrotic areas were observed, representing cloudy swelling and hydropic degeneration.

A characteristic finding following higher doses of radiation was an infiltration of polymorphonuclear leukocytes. This acute cellular inflammatory reaction was observed two days after 3,000 r and was transitory, practically disappearing on the third day. Following higher doses, the polymorphonuclear infiltration sometimes occurred immediately after irradiation and persisted throughout the period studied. This cellular reaction was most marked in the portal areas, often completely filling the portal spaces and extending among the epithelial cells of the bile ducts. Acute inflammatory cells were also present, either as small clumps consisting of 50 to 100 cells localized within the liver parenchyma or diffusely scattered in the hepatic sinusoids. In the degenerated areas, they were particularly abundant and often fragmented. In the portal areas, associated with the polymorphonuclear leukocytes, some mononuclear and lymphocytic cells were seen.

The Kupffer cells were frequently noted as appearing somewhat larger and staining more intensely than normal. The significance of this is not manifest and no phagocytized material was noted within them as described by Warthin and Case (18). The reaction of the bile duct epithelium to the irradiation was inconsistent. In most sections very little alteration could be observed. Others showed slight swelling of the cells of the smaller bile ducts with polymorphonuclear cells among the epithelial cells of the ducts. With the higher doses changes were observed in some of the sections similar to those described by Case and Warthin (1), consisting of degeneration of the cells with an atypical form of regeneration with the formation of eosinophilic giant cells. In some instances cellular debris and polymorphonuclears were noted within the bile ducts. No obstruction of the biliary system was observed as described by Case and Warthin.

In the sections of the liver farthest removed from the direct radiation, slight engorgement of vessels and sinusoids and, to a lesser degree, polymorphonuclear infiltration were observed. This suggests an irradiation effect (from scattering) upon the entire organ or its vessels. On the other

hand, the absence of necrotic foci in these non-irradiated control areas, in the case of the high dosages, suggests that the edema, hyperemia, and leukocytic infiltration may represent an indirect (perhaps chemical) effect upon the entire organ. In the 100,000 r series, there was some evidence of necrosis outside of the direct beam, but the survival period was so short that the full effect may not have developed.

SUMMARY

The effect of single massive doses of roentgen rays (300 r to 100,000 r at 90 kv.) involves all of the component parts of the liver. Edema, hyperemia, and leukocytic infiltration probably are a manifestation of damage to the vascular system. Why edema appears to be most marked in the central part of the lobule and polymorphonuclear leukocytic infiltration in the portal areas is not evident.

The liver cells are damaged or destroyed in proportion to the dosage, very high dosage causing complete necrosis, while the lower dosages produce only slight evidence of damage (swelling). In the lower dosage range, focal destruction of the liver cells is produced, indicating apparently a variable sensitivity to radiation. Repair is rapid when possible; otherwise death occurs, depending upon the dosage and extent of the damage.

NOTE: The author wishes to express his grateful appreciation to Dr. Stafford L. Warren for his guidance in this study and to Dr. William Hawkins for assistance in the interpretation of the histologic preparations.

Part of this study was performed in the Department of Radiology, Rochester Medical School, Rochester, N. Y.

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SUMARIO

Efecto sobre el Hígado de las Dosis Masivas Unicas de Rayos X

A fin de determinar el efecto sobre el hígado de dosis masivas únicas de rayos X, se irradió a conejos con 300 r, 3,000 r, 50,000 r, y 100,000 r sobre el hígado, y con 3,000 r sobre la porción inferior del abdomen, resguardando el hígado.

La respuesta a la irradiación varió ampliamente en distintos animales. En general, la acción afectó todas las partes componentes del hígado. Notáronse edema, hiperemia e infiltración leucocitaria, siendo el edema más pronunciado en la porción central de los lóbulos y la infiltración por leucocitos polimorfonucleares en las zonas de la porta.

Las células hepáticas se lesionaron en proporción a la dosis, ocasionando las dosis muy altas esfacelo total, en tanto que las bajas apenas producían leves signos de lesión (edema). En la escala de dosis bajas la destrucción focal de las células hepáticas reflejó las variaciones a la sensibilidad a la irradiación.

Las dosis muy grandes no fueron bien toleradas por los animales, sobreviniendo frecuentemente la muerte. Aparte de eso, la regeneración fué rápida.

No se observaron alteraciones hepáticas a continuación de la irradiación de la porción inferior del abdomen.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

THIRTY-SEVENTH ANNUAL MEETING

Chicago, Ill., December 2–7, 1951

PRELIMINARY PROGRAM

Monday, December 3

OPENING SESSION: 10:30 A.M.

Call to Order. JOHN S. BOUSLOG, M.D., President

Address of Welcome. H. KENNETH SCATLIFF, M.D., President, Chicago Medical Society

Presidential Address. JOHN S. BOUSLOG, M.D.

The Radiologist in the Rural Tumor Clinic: His Problems and Opportunities. ROBERT C. PENDERGRASS, M.D.

Dental Roentgenologic Aspects of Systemic Disease. EDWARD C. STAFNE, D.D.S. (by invitation).

Panel Discussion on Organization and Function of the American College of Radiology. JOHN D. CAMP, M.D., Chairman of Board of Chancellors, Moderator

AFTERNOON SESSION: 2:00–4:30 P.M.

SYMPOSIUM ON PEDIATRICS

Ira H. Lockwood, M.D., Moderator

Experiences with Benign Bone Tumors in Pediatric Practice. JOHN W. WALKER, M.D.

Wilms' Tumor of Infancy and Childhood. WILLIAM M. BENZING, JR., M.D. (by invitation).

Radiological Diagnosis of Respiratory Lesions in Children. SAMUEL B. CHAPMAN, JR., M.D. (by invitation).

Lesions of the Gastro-Intestinal Tract in Infants and Children. VERNON M. LOCKARD, M.D.

Brain Tumors in Children. ARTHUR B. SMITH, M.D.

EXECUTIVE SESSION: 4:30 P.M.

Tuesday, December 4

MORNING SESSION: 10:30 A.M.–12:30 P.M.

John H. Gilmore, M.D., First Vice-President, Presiding

Acute Diffuse Miliary Diseases of the Lung. BENJAMIN FELSON, M.D.

Studies on the Values of Serial X-Rays in Estimating the Progress of Pulmonary Disease. L. H. GARLAND, M.D., E. R. MILLER, M.D., H. B. ZWERLING, M.D., J. T. HARKNESS, M. D. (by invitation), H. C. HINSHAW, M.D. (by invitation), S. J. SHIPMAN, M.D. (by invitation), AND J. YERUSHALMY, Ph.D. (by invitation).

Anomalous Pulmonary Artery from the Aorta Associated with Intrapulmonary Cysts (Intralobar Sequestration of Lung). STANLEY M. WYMAN, M.D., AND WILLIAM R. EYLER, M.D. (by invitation).

Interpretation of Some Radiologic Signs of Abnormal Pulmonary Function. ROBERT P. BARDEN, M.D.

Bronchial Rearrangement and Bronchiectasis Following Pulmonary Resection. ALICE ETTINGER, M.D., CHARLES BERNSTEIN, M.D. (by invitation), AND FRANCIS M. WOODS, M.D. (by invitation).

The Significance of Unilateral Enlargement of the Hilar Shadow in the Early Diagnosis of Carcinoma of the Lung. LEO G. RIGLER, M.D., BERNARD J. O'LOUGHLIN, M.D. (by invitation), AND RICHARD C. TUCKER, M.D. (by invitation).

AFTERNOON SESSION: 2:00 P.M.–4:00 P.M.

Hugh F. Hare, M.D., Presiding

Forum on the Practical Aspects of Radiation Therapy. W. W. EVANS, M.S. (by invitation), K. R. WRIGHT, M.S. (by invitation), JOHN G. TRUMP, D.Sc. (by invitation), AND HUGH F. HARE, M.D.

Diagnosis and Localization of Organic Lesions of the Central Nervous System Using Radioactive Di-iodofluorescein. LOYAL DAVIS, M.D. (by invitation), AND STANTON L. GOLDSTEIN, M.D. (by invitation).

EXECUTIVE SESSION 4:30 P.M.

THE CARMAN LECTURE 8:00 P.M.

The Concept of a Maximum Permissible Exposure

Robert S. Stone, M.D.
Professor of Radiology, University of California School of Medicine, San Francisco

Wednesday, December 5

MORNING SESSION: 10:30 A.M.—12:30 P.M.

Ivan M. Woolley, M.D., Second Vice-President, Presiding

Roentgen Therapy in Vitreous Hemorrhage and Hemorrhagic Glaucoma. C. E. HUFFORD, M.D., F. C. CURTZWILER, M.D., AND JOHN L. ROBERTS, M.D. (by invitation).

Certain Considerations in the Diagnosis and Treatment of Pulmonary Boeck's Sarcoid. CARLETON B. PEIRCE, M.D., AND JEAN BOUCHARD, M.D., D.M.E. (by invitation).

Roentgen Therapy of Some Common Non-Malignant Diseases. SYDNEY J. HAWLEY, M.D.

Effect of Irradiation on the Development of the Spine. EDWARD B. D. NEUHAUSER, M.D., AND MARTIN H. WITTENBORG, M.D. (by invitation).

Bronchography with Water-Soluble Resorbable Contrast Material. ERIK POPPE, M.D., Oslo, Norway (by invitation).

Therapeutic Effects in Hyperthyroidism from Repeated Tracer Doses of Radioiodine. SIDNEY C. WERNER, M.D. (by invitation), HOWARD HAMILTON, M.D. (by invitation), and MARTHA ROMANCHUK, M.D. (by invitation).

AFTERNOON SESSION: 2:00–4:30 P.M.

SYMPOSIUM ON GASTRITIS

Rocky Mountain Radiological Society

W. Walter Wasson, M.D., Moderator

Review of Literature. WILLIAM S. CURTIS, M.D.

Clinical Aspects of Antral Gastritis and Its Radiological Problem. H. MILTON BERG, M.D.

Exploration of the Gastric Rugae. WENDELL P. STAMPFLI, M.D.

Speculation Concerning the Evolution of Chronic Gastritis. CHARLES F. INGERSOLL, M.D.

Clinical Aspects of Gastritis and Gastroscopic Findings. FRANK B. MCGLONE, M.D. (by invitation).

Difficulty in the Differential Diagnosis of Gastritis and Gastric Cancer—Surgical and Philosophical Considerations. THOMAS J. KENNEDY, M. D.

Pathology of Gastritis. L. W. LARSON, M.D. (by invitation), AND ROBERT R. KLING, M.D. (by invitation).

Pathogenesis of Gastritis. WILLIAM B. DUBLIN, M.D. (by invitation).

Thursday, December 6

MORNING SESSION: 10:30 A.M.–12:30 P.M.

Edward A. Petrie, M.D., Third Vice-President, Presiding

Vitamin D Intoxication. C. B. HOLMAN, M.D.

A Test Examination for Photofluorographic Interpreters. RUSSELL H. MORGAN, M.D., DAVID M. GOULD, M.D., AND WILLIAM ROEMMICH, M.D. (by invitation).

Extraperitoneal Pneumography. HOWARD L. STEINBACH, M.D., EARL R. MILLER, M.D., RICHARDS LYON, M.D. (by invitation), AND DONALD SMITH, M.D. (by invitation).

Some Obscure Factors in the Production of Unusual Small Bowel Patterns. LOWELL S. GOIN, M.D.

A Logical Procedure for the Interpretation of the Step Kymogram. WILLIAM F. WANGNER, M.D.

Horizontal Body Section Radiography. J. J. STEVENSON, M.D., D.M.R., London (by invitation).

AFTERNOON SESSION: 2:00–4:30 P.M.

SYMPOSIUM ON RADIOACTIVE ISOTOPES

Richard H. Chamberlain, M.D., Presiding

Cobalt^{60} Beam Therapy Apparatus. LEONARD G. GRIMMETT, Ph.D. (by invitation) and HERBERT D. KERMAN, M.D.

I^{131}-Labeled Serum Albumin: Its Use in the Study of Cardiac Output and Peripheral Vascular Flow. JOHN P. STORAASLI, M.D. (by invitation), WILLIAM MACINTYRE, M.D. (by invitation), HARVEY KRIEGER, M.D. (by invitation), WALTER PRITCHARD, M.D. (by invitation), AND HYMER L. FRIEDELL, M.D.

Colloidal Radioactive Gold in the Management of Recurrent Ascites and Pleural Effusions. RICHARD H. CHAMBERLAIN, M.D., PAUL O. KLINGENSMITH, M.D. (by invitation), AND JOHN HALE, M.S. (by invitation).

Autoradiography as a Tool in Medicine. GEORGE A. BOYD, M.S. (by invitation).

Radioactive Gallium^{72} in the Therapy of Bone Tumors. MARSHALL H. BRUCER, M.D. (by invitation), H. D. BRUNER, M.D. (by invitation), JESSE PERKINSON, Ph.D. (by invitation), AND GOULD A. ANDREWS, M.D. (by invitation).

EXECUTIVE SESSION: 4:30 P.M.

ANNUAL BANQUET: 7:00 P.M.

Friday, December 7

MORNING SESSION: 10:30 A.M.–1:00 P.M.

Frank L. Hussey, M.D., President, Chicago Roentgen Society, Presiding

Investigation as to Cause of Lymphedema After Radical Mastectomy (Changes in the Axillary Vein Demonstrated by Pre- and Postoperative Venograms). P. E. RUSSO, M.D.

Roentgen Diagnosis of Intra-abdominal Hernia. A. JUSTIN WILLIAMS, M.D.

Abdominal Arteriography. DAVID SHAPIRO, M.D.

A Comparative Postmortem Radiological and Pathological Study of Children's Chests. C. F. WHITNEY, JR., M.D. (by invitation), AND F. W. WIGLESWORTH, M.D. (by invitation).

Roentgen Doses During Diagnostic Procedures. VERN W. RITTER, M.D. (by invitation).

Two Unusual Tumors of the Diaphragm. MAJ. MARVIN M. KEIRNS, MC, U.S.A. (by invitation).

Primary Sarcomas of Bone. GWILYM S. LODWICK, JR., M.D. (by invitation) AND LENT C. JOHNSON, JR., M.D. (by invitation).

CONTINUATION COURSE ROENTGENOLOGY OF CHEST DISEASES

The University of Minnesota announces a continuation course in Roentgenology of Chest Diseases from Oct. 29 to Nov. 3, 1951. The course, which will be conducted at the Center for Continuation Study, is intended for radiologists. The material will include detailed anatomical and pathological studies of the chest presented by means of lectures and demonstrations. Correlation of this material with clinical and roentgen findings will be emphasized. Visiting faculty members of the course include Dr. W. Edward Chamberlain, Temple University, Philadelphia; Dr. Benjamin Felson, University of Cincinnati; Dr. L. Henry Garland, Stanford University, San Francisco; Dr. George R. Krause, Mount Sinai Hospital, Cleveland; and Dr. Averill A. Liebow, Yale University, New Haven.

Dr. Chamberlain will give the annual Leo G. Rigler Lecture in Radiology on the evening of Thursday, Nov. 1. Chairman for the course will be Dr. Rigler, Professor and Head of the Department of Radiology. He will be joined by the members of the faculty of the University of Minnesota Medical School and the Mayo Foundation.

Fees for the course are as follows: registration, $5.00; tuition, $35.00; total, $40.00. The registration fee of $5.00 is payable with application; the balance upon arrival.

As enrollment for the course is limited, applications should be mailed immediately to the Director, Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

POSTGRADUATE COURSE ROENTGENOGRAPHIC INTERPRETATION OF DISEASES OF BONES AND JOINTS

A postgraduate course in roentgenographic interpretation of the diseases of bones and joints will be held at the Hospital for Joint Diseases, 1919 Madison Avenue, New York City, in affiliation with Columbia University, College of Physicians and Surgeons, from Oct. 3 through Dec. 19, 1951. This will consist of a series of lectures covering the radiographic analysis of acute and chronic diseases of bones and joints, including granulomata, neurotrophic lesions, neoplasms, and the manifestations of nutritional and metabolic bone changes in children and adults. The lectures, which will last about one hour, will be followed by lantern slide demonstrations illustrating the diseases under discussion. An average of approximately thirty-five to fifty lantern slides will be shown at each session, all representing material selected from cases seen at the Hospital for Joint Diseases during the past twenty-five years.

Further information may be obtained by addressing Miss Amelia Mater, Hospital for Joint Diseases, 1919 Madison Ave., New York 35, N. Y.

AMERICAN COLLEGE OF CHEST PHYSICIANS

The Interim Session of the American College of Chest Physicians will be held at the Ambassador Hotel, Los Angeles, Calif., on Dec. 2 and 3, 1951. On Sunday, Dec. 2, a scientific session will be presented sponsored by the California Chapter of the College, including round table luncheon discussions and an x-ray conference. A banquet will be held in the evening. The Board of Regents of the College will meet on Monday, Dec. 3, as well as various councils and committees of the College.

Dr. Edward W. Hayes, Monrovia, Calif., is chairman of the general arrangements committee and Dr. Alfred Goldman, Beverly Hills, is chairman of the scientific program committee.

ERRATUM

Attention is called to an error in an abstract of a paper on Contrast Visualization of the Peridural Space, appearing on pages 912–913 of the June 1951 issue of RADIOLOGY. In line 15 of the first column on page 913 the solution of pantocain should be 0.33 per cent. In the original German contribution (Fortschr. a. d. Geb. d. Röntgenstrahlen **72;** 703, 1950) the figure was given as 3,3 ‰, which was erroneously interpreted in the appended English, French, and Spanish summaries as 3.3 per cent. We regret the repetition of this error in RADIOLOGY.

Letter to the Editor

To the Editor of Radiology

DEAR DOCTOR DOUB:

This is a request that you call attention in the pages of RADIOLOGY to a questionnaire to be sent out within the next few weeks concerning the frequency of congenital deformities among workers in the field of x-radiation. This National Survey, made possible by a grant-in-aid from the U. S. Public Health Service, will help determine the effects of ionizing radiation on the genetic structure of man. It should also indicate whether the present radiation tolerance limits and protective standards are satisfactory and whether they should be modified.

The questionnaire will be sent to approximately 4,000 radiologists and other workers in the field of radiation and to a similar number of physicians who do not come into contact with x-rays. A biostatistician will analyze the results. A small pilot study has

already indicated that further investigation of this problem should be carried out. For example, one radiologist has been found to have a congenitally deaf child; the child of a second radiologist had a diagnosis of congenital deafness but subsequently gave evidence of regained hearing; a third radiologist had a child with congenital absence of one ear.

It is the writer's hope that each radiologist will complete the questionnaire with great care and thereby contribute to the significance and value of this important study.

Sincerely,
STANLEY H. MACHT, M.D.
Hagerstown, Md.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

TUMORS OF THE PERIPHERAL NERVOUS SYSTEM. Section II, Fasc. 6, of Atlas of Tumor Pathology. By ARTHUR PURDY STOUT, M.D., Professor of Surgery, Columbia University, College of Physicians and Surgeons, New York City. A monograph of 58 pages, with 56 illustrations. Published by the Armed Forces Institute of Pathology, under the Auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, Washington, D. C., 1949. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price $.60.

TUMORS OF THE MEDIASTINUM. Section V, Fasc. 8, of Atlas of Tumor Pathology. By HANS GEORGE SCHLUMBERGER, M.D., Professor of Pathology, Ohio State University, College of Medicine, Columbus, Ohio. A monograph of 88 pages, with 75 illustrations in black and white and 1 color plate. Published by the Armed Forces Institute of Pathology, under the Auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, Washington, D. C., 1951. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price $.75.

TUMORS OF THE ADRENAL. Section VIII, Fasc. 29, of Atlas of Tumor Pathology. By HOWARD T. KARSNER, M. D., Medical Research Advisor, Bureau of Medicine and Surgery, U. S. Navy, formerly Professor of Pathology, Western Reserve University. A monograph of 60 pages, with 47 illustrations in black and white and 5 color plates. Published by the Armed Forces Institute of Pathology, under the Auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, 1950. For sale by American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price $1.00.

TUMORS OF THE BREAST. Section IX, Fasc. 34, of Atlas of Tumor Pathology. By FRED W. STEWART M.D., Pathologist to Memorial Hospital, Professor of Pathology, Cornell University Medical School, Attending Pathologist of New York Hospital, New York City. A monograph of 114 pages, with 68 illustrations in black and white and 2 color plates. Published by the Armed Forces Institute of Pathology, under the auspices of the Subcommittee on Oncology of the Committee on Pathology of the National Research Council, Washington, D. C., 1950. For sale by the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Price $1.10.

MEDICAL RADIOGRAPHIC TECHNIC. Prepared by the Technical Service Department of the General Electric X-Ray Corporation, under the editorial supervision of GLENN W. FILES, Director. A volume of 370 pages, with 382 figures. Revised seventh printing, 1951. Published by Charles C Thomas, Springfield, Ill.

MICRO-ARTERIOGRAPHY AND OTHER RADIOLOGICAL TECHNIQUES EMPLOYED IN BIOLOGICAL RESEARCH. By ALFRED E. BARCLAY, O.B.E., M.D., D. Sc. (Hon.) Oxon., D.Sc. (Hon.) Manchester, F.R.C.P., F.F.R., F.A.C.R., Honorary Radiologist to the Nuffield Institute for Medical Research, Oxford. A volume of 102 pages, with 46 illustrations. Published by Charles C Thomas, Springfield, Ill., 1951. Price $6.75.

THE MEDICAL ANNUAL. A YEAR BOOK OF TREATMENT AND PRACTITIONERS' INDEX. Editors: SIR HENRY TIDY, K.B.E., M.A., M.D. (Oxon), F.R.C.P., and A. RENDLE SHORT, M.D., B.S., B.Sc., F.R.C.S. A volume of 366 pages. Published by John Wright & Sons Ltd., Bristol, and Simkin Marshall Ltd., London, 1951.

ÜBER DIE RÖNTGENOLOGISCHEN DARSTELLUNGSMÖGLICHKEITEN DES WEIBLICHEN GENITALAPPARATES MIT HILFE VON JODÖL UND JODSOL. Ergänzungsband 58, Fortschr. a. d. Geb. d. Röntgenstrahlen. By Dozent Dr. med. habil. J. ERBSLÖH, Bad Oldesloe. A volume of 74 pages, with 64 illustrations. Published by Georg Thieme, Stuttgart, 1951. Sole distributors for U.S.A. and Canada: Grune & Stratton, Inc. 381 Fourth Ave., New York 16, N. Y.

DIAGNOSTIC ENCÉPHALOGRAPHIQUE. ENCÉPHALOGRAMMES NORMAUX ET PATHOLOGIQUES. PATHO-

LOGIE DU LIQUIDE CÉPHALIQUE. By PIERRE DURAN, Médecin des hôpitaux militaires, Chef de Service de neuro-psychiatrie de l'Hôpital militaire d'instruction Desgenettes, with the collaboration of H. GARNUNG and R. COIRAULT, Médecins des hôpitaux militaires. A volume of 192 pages, with 26 figures. Published by G. Doin & Cie, Paris, 1951. Price 1,100 fr.

LES ONDES COURTES EN THÉRAPEUTIQUE. By JEAN SAIDMAN, Fondateur de l'Institut d'Actinologie, and JEAN MEYER, Chef du laboratoire de Finsenthérapie à l'Hôpital St-Louis. With a Preface by Professor d'Arsonval. A volume of 262 pages, with 85 figures. Published by G. Doin & Cie, Paris, 3rd revised ed., 1951. Price 1,500 fr.

EINFÜHRUNG IN DIE RÖNTGENPHOTOGRAPHIE. By Dr. Dr. Ing. e. h. JOHN EGGERT, O. Professor an der Eidg. Tech. Hochschule, Zürich, unter Mitwirkung des Röntgen-Institutes am Kantonsspital Zürich (Direktor: Dr. H. R. Schinz, O. Professor an der Universität Zürich). A volume of 236 pages, with 65 illustrations and 26 tables. S. Hirzel Verlag, Zürich, 7th ed., 1951. Price 20 fr

VERLETZUNGEN DER LUNGEN UND DES BRUSTKORBES FRÜHVERLAUF UND SPÄTFOLGEN MIT BESONDERER BERÜCKSICHTIGUNG DER LUNGENTUBERKULOSE. KRITISCHE BEOBACHTUNGEN ÜBER 3 JAHRZEHNTE AN FAST 4000 VERLETZTEN DES WELTKRIEGES 1914/1918. By DR. WALTER STEFFENS. Oberregierungsmedizinalrat i. R., ehemals Chefarzt der Versorgungsärztlichen Untersuchungsstelle Berlin. A volume of 320 pages, with 111 figures. Published by Georg Thieme, Stuttgart, 1951. Sole distributors for U.S.A. and Canada: Grune & Stratton, Inc , 381 Fourth Ave., New York 16, N. Y.

Book Reviews

CHEST X-RAY DIAGNOSIS. By MAX RITVO, M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; Roentgenologist-in-Chief and Director, Department of Radiology, Boston City Hospital; Associate Radiologist, Beth Israel Hospital, Boston, Mass.; Radiologist, Jewish Memorial, Hospital, Jewish Tuberculosis Sanatorium of New England, Revere Memorial Hospital, and Hudson Hospital. A volume of 558 pages, with 615 illustrations on 418 engravings and a colored plate. Published by Lea & Febiger, Philadelphia, 1951. Price $15.00.

The diagnosis of diseases of the chest has long been recognized as one of the most difficult problems in the field of radiology. The author presents in this volume the summary of his long experience. The contents, as the title implies, covers all the structures found within the chest, as well as the chest wall and the soft tissues of the neck. The text is divided into ten sections, *viz.*: the lungs, the mediastinum, the diaphragm, the pleura, the bony thorax and soft tissues of the chest wall, the soft tissues of the neck, the heart and great vessels, the aorta, the pulmonary artery, and the pericardium.

The descriptive matter is in most instances concise, occasionally appearing almost too limited to deal adequately with the subject under discussion. This, however, may be excused since it is manifestly impossible to cover in great detail all of the lesions in the chest and neck in a single volume. All in all, the book represents an excellent job of bringing together the main clinical and roentgenologic findings in diseases of the chest. The short bibliographies appended to many of the sections offer useful suggestions for additional reading.

The volume is well bound and attractively printed, with numerous illustrations, most of which are of good quality. It will be of interest not only to radiologists, but will prove to be a valuable reference work for clinicians and surgeons who are interested in lesions of the lungs, heart, and neck.

LE SYNDROME DE MORGAGNI-MOREL: ÉTUDE ANATOMO-CLINIQUE. HYPEROSTOSE FRONTALE INTERNE, ADIPOSITE, VIRILISME ET TROUBLES NEURO-PSYCHIQUES. By ANDRÉ CALAME, Institut de Pathologie de Genève. With preface by Dr. E. Rutishauser, Professeur à la Faculté de Médecine de Genève. A volume of 154 pages, with 27 illustrations. Published by Masson et Cie, Paris, 1951. Price 700 fr.

This monograph is an attempt to survey most of the known facts about the syndrome of Morgagni-Morel. The following abstract indicates the scope of the work.

Morgagni, in 1719, spoke of frontal exostoses and described a case at autopsy. In 1761, he presented a case of hyperostosis frontalis interna. Numerous workers described cases in the ensuing years until, in 1928, Stewart published his work on localized cranial hyperostosis in the insane, noting the association of hyperostosis frontalis interna with mental disease and with a pituitary type of obesity. In 1930, Morel contributed an important clinical study of 17 cases and definitely helped to bring the condition to the attention of physicians.

Moore (1935–1936) reported a series of radiologic studies in which he divided exostoses into four groups: nebula frontalis, hyperostosis calvariae diffusa, hyperostosis frontalis interna, and hyperostosis fronto-parietalis. In 1937, Henschen published a monograph on hyperostosis frontalis interna with obesity and called attention to the occurrence of virilism in many cases. According to him, about 40 per cent of women who have passed the menopause present cranial exostoses. In 1947, Schneeberg and collaborators stated that hyperostosis frontalis interna is a not uncommon incidental skull thickening

in women that is unrelated to whatever clinical state may accompany it.

The present study is based on 60 cases: 44 which were studied anatomically and had little clinical study and 16 cases which had received fuller investigation.

The pathologic studies revealed that the osteoplastic process in the frontal bone is exclusively from the inner table. Apparently after the bony overgrowth is formed, somewhat spongy cavities filled with marrow develop. The process may then stabilize and even undergo involution, seen in the form of microscopic areas of necrosis. The theory that the hyperostosis is due to traction of the dura mater the author believes should be abandoned.

Several factors are offered in an attempt to explain the localization of hyperostosis in the region of the frontal bone. The frontal bone is the only bone of the vault which receives circulation from the internal carotid artery, being irrigated by the anterior meningeal artery, a small branch of the ethmoid artery, which in turn is a branch of the ophthalmic. Its blood supply is the same as that of the falx, which also is a common site of osteomas. The frontal portion of the dura mater is thick and has less blood supply than other portions of the dura. The frontal bone has very few muscular insertions.

The theory that the skull creates a hyperostosis to compensate for a region of cerebral atrophy does not seem to the author to correspond to facts. No consistent histologic changes are noted in the pituitary gland, which did, however, show an increase in basophilic cells at times. There was no modification of the basophiles in the sense described by Crook in Cushing's syndrome.

Several clinical facts are cited as of importance. The hyperglycemia provoked by injection of adrenalin gives a pathologic curve. Serologic tests for syphilis have no consistent relationship. Blood calcium, phosphorus, and phosphatase show no consistent changes. The serum cholesterol often is slightly elevated. Encephalography and arteriography contribute little. Electroencephalographic changes are interesting, depicting an abnormal focus in the diencephalon which projects its action upon the pre-fronto-frontal region. Lumbar puncture usually reveals elevated pressure.

The syndrome may appear in the early decades of life and may be altered by the aging process, especially with the loss of weight. In 4 cases skull roentgenograms made over a period of years revealed no important modifications of the frontal bone. Neuropsychiatric troubles vary considerably but are present in most of the cases, and the author suggests that many of them may be traced ultimately to the diencephalon.

The etiology of this condition is not clear. Many cases do show genital dystrophy. The male who has the syndrome assumes a feminine aspect while the female assumes a masculine aspect. It is suggested that the adrenal glands may be involved, secondarily affecting the diencephalon. If this theory is confirmed, it would explain the rarity of the syndrome in males.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Charles E. Duisenberg, M.D., 300 Homer Ave., Palo Alto. Meets monthly, second Tuesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45 January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wendell P. Stampflis, M.D., 1933 Pearl St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Theodore M. Berman, M.D., 350 Lincoln Road, Miami Beach. Meets monthly, last Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and with State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. John's Hospital, Springfield. Meets quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Donald S. Bottom, M.D., 510 S. Kingshighway Blvd. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets at University Club, Albany, second Wednesday, October, November, and March. Annual Meeting in June to be announced.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lawrence Gibboney, M.D., Carew Tower Bldg. Meets first Monday, September to May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St, Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 18–19, 1952, Houston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meets fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Jean Bouchard, M.D. Assoc. Hon. Secretary-Treasurer, D. L. McRae, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 26, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, Mexico, D. F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

PUERTO RICO

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Musculoskeletal System

Gynecology and Obstetrics

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Positive Contrast Ventriculography. J. W. D. Bull. Acta radiol. **34:** 253–268, October–November 1950.

In the opinion of the author, air has qualities equaled by no other contrast substance yet developed for demonstrating the ventricular system. It is non-toxic, easy to manipulate, and easily absorbed. It costs nothing and is universally available. It has one limitation—when a small or narrow cavity requires filling, the air shadow may be so faint as not to be recognizable on the roentgenogram. The lateral ventricles of the brain, however, are nearly always large enough to be well outlined with air, provided enough air is present. Very occasionally one lateral ventricle may be so crushed as to have such a small capacity that the air contained in it produces a shadow inadequate for diagnostic purposes.

The small third and fourth ventricles and the aqueduct of Sylvius, which joins them, present a rather different problem. Air is sometimes not an ideal contrast substance for their delineation, for two reasons. The first is that they are such small structures, having a total capacity of only about 2 c.c., that the shadow cast by the air, even when they are filled, is rather thin. It is true that they can nearly always be well outlined when air is introduced from below by cisternal or lumbar injection, but many workers are reluctant to do this if increased intracranial pressure is suspected. In cases where air is introduced via the lateral ventricles (ventriculography), outlining of the hindmost part of the ventricular system can be very difficult, if not impossible, when these structures are not dilated. The second reason why the back of the third ventricle, aqueduct, and fourth ventricle sometimes cannot be outlined is the difficulty of manipulating the air.

Illustrative cases are presented in which introduction of myodil (pantopaque) was necessary to obtain a satisfactory shadow.

Eighteen roentgenograms; 3 photographs; 5 drawings.

A Special Device for Encephalography. B. G. Ziedses des Plantes. Acta radiol. **34:** 408–410, October–November 1950.

Since 1934 encephalography has been carried out by the author by means of suboccipital puncture, with the patient lying on his back, the upper part of the body being somewhat raised and supported by a cylindrical cushion. The head of the patient is placed in such a position that the lower margin of the orbit is level with the exterior auditory canal. Since 1941 a special device has been employed, by means of which it is possible to make radiographs during the insufflation. This device closely resembles that described by Busch (Acta psychiat. et neurol. **19:** 61, 1944). A cross-bar, bearing the head support, can be moved up or down along two vertical supports. If one wishes to check the air filling radiographically, a removable holder for the cassette is hooked onto the support. If an anteroposterior radiograph is desired, the holder is removed, the crossbar reversed, and the holder is hooked on the support in the appropriate position.

Usually about 25 c.c. of air are injected, 5 c.c. at a time, after removal of the same quantity of liquid, check radiographs being made to determine that results are satisfactory. If large ventricles are expected, the first film is exposed after the injection of 35 c.c. of air.

When the examination of the ventricular system is completed, the air can be conveyed to the subarachnoid spaces as described in another article (Acta radiol. **34:** 399–407, 1950. Abst. in Radiology **57:** 443, 1951).

One drawing; 2 photographs.

Encephalographic Examination of Tumours in the Posterior Fossa. E. Lindgren. Acta radiol. **34:** 331–338, October–November 1950.

The general opinion seems to be that encephalography should be employed only in cases where there is no evidence of an intracranial expanding lesion. Clinical symptoms of tumor in the posterior fossa are regarded as a direct contraindication to this procedure. In the author's opinion, such ideas must date from experiences in the earliest days of encephalography. When his technic (Acta radiol. **31:** 161, 1949. Abst. in Radiology **54:** 130, 1950) is used, a moderate increase in intracranial pressure, even if this is due to an infratentorial expanding lesion, is not in itself a contraindication to encephalography.

The value of encephalography in posterior fossa tumors is demonstrated, and examples are presented to illustrate that an investigation of the cisterns in many cases is a valuable complement to examination of the ventricular system. In certain cases, particularly those of tumor in the cerebellopontine angle, encephalography supplies more accurate information than ventriculography.

Fourteen roentgenograms.

Rapid Serial Angiography. Walpole Lewin. Acta radiol. **34:** 319–320, October–November 1950.

A method of rapid serial cerebral angiography has been devised by means of which twenty-five 8 × 10-inch films can be exposed at intervals of one-half, two-thirds, and one second. The technic has previously been described by Curtis (J. Neurol., Neurosurg. & Psychiat. **12:** 167, 1949. Abst. in Radiology **55:** 137, 1950). Some preliminary observations in 33 cases are described. These indicate the possibilities of the method in the physiological study of the cerebral circulation.

Tolerance of Cerebral Blood Vessels to Contrast Media of the Diodrast Group in Animal Experiments and in Man. Olle Olsson. Acta radiol. **34:** 357–360, October–November 1950.

Further studies have been carried out in animals and in man on the effect of water-soluble contrast media of the diodrast group on the cerebral blood vessels (see Broman and Olsson: Acta radiol. **30:** 326, 1948, and **31:** 321, 1949. Abst. in Radiology **53:** 624, 1949, and **54:** 767, 1950; Broman, Forssman, and Olsson: Acta radiol. **34:** 135, 1950. Abst. in Radiology **56:** 901, 1951).

On the basis of these experiments and clinical experience, the author believes it is advisable to use as weak a solution of contrast medium as possible in cerebral angiography; a 35 per cent solution is as a rule strong enough. Should a 50 per cent solution occasionally be necessary, it should be administered in a single dose and

should never be injected directly into the internal carotid. If repeated injections are given, as is often the case in cerebral angiography, they should not follow in quick succession. One should try to test the various contrast media pharmacodynamically and then select those with the least effect on the walls of the cerebral vessels.

Cerebral Stereoangiography. B. G. Ziedses des Plantes. Acta radiol. **34**: 411–417, October–November 1950.

A device for cerebral angiography is described by means of which the injection of the contrast liquid and the intermediate infusion of saline is performed automatically.

A method is also described by which the involuntary movements of the patient's head are corrected by placing the radiographs in the stereoscope in a special manner.

One photograph; 12 drawings.

Intracranial Arterial Aneurysms. Preliminary Report. Stig Löfstedt. Acta radiol. **34**: 339–349, October–November 1950.

Löfstedt believes that there are no contraindications to cerebral angiography other than those for ordinary intravenous urography. Approximately 450 angiographic examinations have been carried out at the Södersjukhuset, Stockholm, without one serious complication. The percutaneous method of Lindgren (Brit. J. Radiol. **20**: 326, 1947. Abst. in Radiology **51**: 123, 1948) and Wickbom (Acta radiol. Suppl. 72, 1948) is used. Straight anteroposterior and lateral projections are always taken and very often a 35° oblique anteroposterior view. In cases of subarachnoid hemorrhage or suspected aneurysm, oblique views are obtained as well.

The following routine has been adopted for angiography in cases in which aneurysm is suspected: After the usual straight lateral view, the patient's head is turned 30 to 45° toward the affected side and new pictures are made with smaller primary diaphragms, the size of the diaphragm being adjusted so that the circle of Willis and the thicker branches leading from it are included. Practically all arterial aneurysms are located in the central vessels, and it is just these aneurysms that can be hidden by vessel branches projecting over each other. The roentgen tube is then positioned for the usual so-called "straight frontal picture," an anteroposterior view, which is taken with the ordinary skull diaphragm. The last of the four obligatory films is an oblique frontal view with the head of the patient 35 to 45° toward the normal side and the tube 15 to 20° cranially. It is important that the primary diaphragm be as small as possible and that the secondary diaphragm (Lysholm grid) be used so that the smallest details shall be as sharply defined as possible. It is seldom found necessary to take more than two pictures, with two to four seconds interval after each injection.

After the arterial phase is completed, the examination is interrupted and the roentgenograms are inspected while still wet. If the diagnosis is not conclusive, further studies are made, taking into account the shape of the skull and the course of the vessels. Sometimes as many as 10 injections (100 ml. 35 per cent umbradil) have been made during the course of an examination.

Since 1944, 16 aneurysms have been diagnosed roentgenologically at the Södersjukhuset. Thirteen of these were about the size of a hazelnut kernel or smaller, *i.e.*, with a diameter of 8 to 10 mm. at the most. Of 17 arterial aneurysms treated during 1948 and 1949, 13 were diagnosed by arteriography and 4 postmortem. Seven of these aneurysms were located in the anterior communicating artery or in the anterior cerebral artery immediately beside the anterior communicating artery, and only 2 in the internal carotid. There were 3 aneurysms of the middle cerebral and 3 of the anterior cerebral artery. The remaining 2 aneurysms were derived from the posterior cerebral artery and the vertebral artery.

Seventeen roentgenograms; 1 photograph; 1 drawing.

Angiographic Examination of Intracranial Arterio-Venous Aneurysms. Ingmar Wickbom. Acta radiol. **34**: 385–398, October–November 1950.

At the Serafimer Hospital, Stockholm, percutaneous puncture is now used routinely for cerebral angiography, and at no time in recent years has it been necessary to resort to exposure of the vessel. One series of lateral views and two series of anteroposterior views are taken, one with the rays parallel to the line between the eye and the external auditory canal and the other with the tube angled 30 to 35° cranially. To avoid turning the patient's head, a special cassette holder has been built. This consists of a vertically placed part for lateral views and one horizontally placed part for anteroposterior views. Accordingly the lateral pictures are taken with a horizontal beam and the anteroposterior picture with vertically directed rays. A water-soluble iodine salt (umbradil), usually in 35 per cent solution, is used as the contrast medium. The needle remains in position during the entire examination and between contrast injections normal saline solution is injected to retard coagulation in the needle.

The angiographic appearance of arteriovenous aneurysm is usually typical and diagnosis is relatively easy if a proper technic is used, the aneurysm appearing as a well defined wedge-formation of closely placed, small, tortuous vessels, which cross each other irregularly so that the whole has the appearance of a ball of twine. Leading to this ball are one or more arteries, generally considerably dilated and with a tortuous course. Differential diagnostic difficulties, however, do arise. Malignant tumors, especially glioblastomas, may contain such an abundance of irregular, newly formed vessels that they are not obviously distinguishable from aneurysms. Two cases are presented, which illustrate the similarities and the differences between arteriovenous aneurysms and glioblastomas.

At the Serafimer Hospital, arteriovenous aneurysms are treated in most instances by extirpation. The results of operation are checked by angiography one to two months later, by which time the dilated feeding and draining vessels should have regained their normal width.

Thirty-two roentgenograms.

Complications Following the Use of Neo-Iopax in Cerebral Angiography. Lyle A. French and Paul S. Blake. Am. J. Roentgenol. **64**: 816–818, November 1950.

An evaluation of neo-iopax for use in cerebral angiography was made to determine its merit as compared to diodrast (35 per cent) or thorotrast (25 per cent).

Nine patients were injected with neo-iopax (50 per cent), being selected for this examination on the same criteria as are used for diodrast and thorotrast. Premedication was the same as in patients in whom the other media were used, consisting of sodium amytal (3 grains) the preceding evening, codeine (1 grain) and scopolamine ($^1/_{150}$ grain) one hour before examination. Procaine (1 per cent) was the local anesthetic used in the percutaneous approach to the common carotid artery. Ten per cent of patients required pentothal anesthesia. In 6 per cent surgical exposure of the artery was necessary. Eight cubic centimeters of neo-iopax, were given as rapidly as possible (two seconds)

Four of the 9 patients had convulsive seizures and these tended toward a state of status epilepticus in spite of pentothal sedation. One patient died and autopsy showed throughout the right hemisphere numerous ball and ring type petechial hemorrhages believed to be secondary to vascular irritation by the neo-iopax. In view of these findings, it is felt that neo-iopax should not be used as a contrast substance in cerebral angiography.

One photomicrograph; 2 tables.

MILTON SEGAL, M.D.
Cleveland City Hospital

Radiography of the Fetal Skull. Th. Berkvens. Acta radiol. **34**: 250–252, October–November 1950.

An investigation was made by the author of the possibility of studying the gradual development of the fetal skull roentgenographically. About 30 undamaged specimens of fetus and embryos of various ages were available for the study, ranging from a fetus with a total length of 18 mm. to a completely developed child. Stereoscopic roentgenograms were made in the anteroposterior, lateral, and axial views. Some skulls were also examined by the Stenvers technic. For demonstrating the petrous bones of the fetal skull, the axial view proved to be the more useful.

The voltage was kept as low as possible, 25–30 kv. for the smaller and a maximum of 40 kv. for the larger skulls. Preference was given to films used without intensifying screens, the so-called fine-grain film, from which enlargements can be made. The exposure was, however, greatly increased, up to forty seconds. For the larger skulls, the Potter-Bucky diaphragm was employed to avoid diffusion; a primary diaphragm was always used for the small skulls. Stereoscopic films were made by shifting the x-ray tube, with the object placed on a small tunnel, almost resting on the film.

The author believes that roentgen investigation of the skull can be applied in embryology, offering by stereoscopy the advantage of three-dimensional study.

Six roentgenograms.

On Roentgen Examination in Head Trauma (A Preliminary Report from the Past Five Years). Arne Engeset. Acta radiol. **34**: 288–298, October–November 1950.

All cases of post-traumatic intracranial hematoma seen at the University Hospital, Oslo, during a five-year period, and verified at operation or at autopsy, have been reviewed. The series included 6 epidural, 23 subdural, and 4 intracerebral hematomas.

Roentgen examination of the skull was carried out in 23 patients, disclosing 11 cases of fracture, including all of the epidural hematomas. In 9 patients a calcified pineal gland was demonstrated, with displacement in all. Six cases showed signs of increased intracranial tension (5 cases of subdural hematoma and 1 case of intracerebral hematoma).

Cerebral angiography, which the author thinks is underrated as a diagnostic procedure in head trauma, was performed in 28 patients, and in 27 the information obtained was of the greatest diagnostic significance. In 19 cases the type of lesion was demonstrated, and in 6 others its probable nature was suggested.

Pneumography was carried out in only 4 cases and did not yield important supplementary information.

In 32 cases surgery was resorted to; 25 of the patients recovered. Angiography is believed to have been an important factor in achieving this satisfactory result.

Ten roentgenograms.

A Short Review of Cranial Hyperostoses. A. Schüller. Acta radiol. **34**: 361–373, October–November 1950.

Hyperostotic changes in the cranial bones are not often encountered in the routine roentgen examination of cranial and endocrine conditions, with the exception of those of Paget's disease and hyperostosis frontalis interna. Cranial hyperostosis is not rarely a part of a generalizedskeletal abnormality, *e.g.*, in acromegaly or Albers-Schönberg disease. The hyperostotic changes of the skull itself are either diffuse or localized in one or more areas. The calvaria, base of the skull, ard facial bones may be involved.

Hyperostosis may be spoken of as concentric or eccentric, the former referring to thickening of the internal cranial wall and the latter to enlargement of the cranial wall externally.

The structural appearance of cranial hyperostoses shows great variability. The cranial wall may be thickened without alteration of its texture, *e.g.* in acromegaly; the hyperostotic structure may be compact, sclerosed, eburnated, porotic, spongy, honeycomb, trabeculated, spicular, vascular, cystic, shell-like, sequestrum-like, or pneumatized. A combination of the different types is occasionally present in the same case. The differential diagnosis of hyperostosis is discussed under the following etiologic headings: (1) Congenital Hyperostosis (marble bone disease or osteopetrosis; hyperostotic craniostenosis; caput natiforme congenitum; fibrous dysplasia; osteopoikilosis; racial hyperostosis); (2) Compensatory Hyperostosis; (3) Endocrine Hyperostosis (acromegaly; hyperostosis frontalis interna; osteitis fibrosa cystica generalisata; hyperostosis cranialis gravidarum); (4) Dyscrasic Hyperostosis (rickets, renal rickets, chronic hemolytic anemias); (5) Dystrophic Hyperostosis (Paget's osteitis deformans); (6) Inflammatory Hyperostosis (syphilis; chronic osteomyelitis; xanthomatous hyperostosis); (7) Traumatic Hyperostosis; (8) Neoplastic Hyperostosis (osteomas; osteosarcoma; osteoblastic malignancy; hemangioma-hyperostosis; meningioma-hyperostosis).

One roentgenogram.

Pituitary Tumors. Progress of Medical Science. Russell H. Morgan. Am. J. M. Sc. **220**: 577–590, November 1950.

In view of the progress during the past several years in the diagnosis and treatment of pituitary tumors, the

tuthor reviews the radiological and associated literature on this subject.

Pituitary tumors comprise approximately 10 per cent of the neoplasms of the brain. In general, they are of two principal types, the adenomas and the craniopharyngiomas. The former make up approximately 70 per cent of the total and arise from mature cellular elements of the gland. They are classified as chromophobe, acidophil, and basophil. The craniopharyngiomas, comprising about 30 per cent of all pituitary tumors, are congenital cysts arising from remnants of Rathke's pouch and usually are suprasellar in origin.

Among the various pituitary tumors, the outlook for the chromophobe adenoma is the most satisfactory. Either radiation therapy or surgery, or a combination of the two, controls the local effects of the lesion in a high percentage of cases and the systemic endocrine manifestations are usually minimal in extent. Furthermore, it now appears that the tumor may be diagnosed in its presymptomatic state, at a time when therapy is most successful, by means of roentgen studies of the sella turcica. A patient with an enlarged sella turcica, *i.e.*, one greater than 130 sq. mm. in its lateral plane area, should be suspected of having a chromophobe adenoma even in the absence of visual or other symptoms, and the roentgenograms of the skull should be repeated after an interval of three to six months to demonstrate an additional increase in sellar size, even though symptoms may not yet have appeared. Radiation therapy instituted at this time will almost certainly cause permanent regression of the lesion and will prevent the dangers which follow further growth of the tumor.

The prognoses of the remaining lesions of the pituitary gland are rather discouraging. This is particularly so in the case of the basophil adenoma.

Little or no progress has been made recently in combating the acidophil adenoma or the craniopharyngioma. Radiation methods appear to have gone as far as they are able in the case of the former tumor, and surgery seems to have reached its maximum position in the case of the craniopharyngioma. Earlier diagnosis may well be the key to the solution of the problems which these tumors pose. In this connection it does not seem that better diagnostic methods are required as much as the earlier appearance of the patient at the office of his physician for the application of the methods now at our disposal.

Two tables.

A Roentgenographic Aid in the Diagnosis of Retinoblastoma. Harold Fulton. Am. J. Roentgenol. **64**: 735–739, November 1950.

Since retinoblastoma is the commonest form of retinal glioma in infants and children, and since it has an insidious and rapid growth, early diagnosis is imperative. Diagnosis in its earliest stages is extremely difficult. Preservation of the eye is important, as in an infant it is needed to mold the bony orbit. However, unless a benign disease can be definitely established, enucleation is mandatory.

The clinical course of retinoblastoma is divided into four stages. The first stage is that of intraocular growth. The second stage is the formation of a glaucoma. The third stage is that of extraocular extension, and the fourth that of metastasis.

In discussing the pathological features, the author states that it is of some importance that degenerative changes, especially calcification, are common. The degeneration involves the cells farthest removed from the blood vessels. It is in these areas that the calcium is deposited, even in the earliest tumors.

The presence of calcification within a retinoblastoma is known to the ophthalmologist but has received little attention from the radiologist. The most comprehensive study is that of Pfeiffer (Arch. Ophth. **15**: 811, 1936), who concluded that in approximately 75 per cent of cases of retinoblastoma there is sufficient calcareous degeneration to be seen radiographically and that the irregular and granular calcium density thus demonstrated in children is pathognomonic.

Roentgenograms may or may not show a soft-tissue mass. In either event, a rounded mass of mottled calcification may be demonstrated in the eye. On careful examination this is seen to consist of closely packed calcified nodules approximately 1 mm. in diameter. Infiltration of the tumor along the optic nerve is common and the optic foramen may show changes.

In the years 1947 to 1949 inclusive, 4 cases of retinoblastoma were studied radiographically at Harper Hospital and Children's Hospital of Michigan (Detroit) prior to operation. Three of the 4 showed calcification, and in all 4 calcification was found by the pathologist. Two of the cases are presented, both of which showed calcification radiographically.

Several conditions which may simulate a retinoblastoma are grouped under the term "pseudoglioma." Any calcification seen in such lesions in no way resembles the flaky, irregular mass of calcium characteristic of retinoblastoma.

Three roentgenograms; 4 photomicrographs.

NELSON E. KLAMM, M.D.
Cleveland City Hospital

Thyroid Cancer in Childhood and Adolescence. A Report on Twenty-Eight Cases. B. J. Duffy, Jr., and Patrick J. Fitzgerald. Cancer **3**: 1018–1032, November 1950.

In a sixteen-year period from 1932 to 1948, inclusive, 430 cancers of the thyroid were studied at the Memorial Hospital, New York. Only 28 patients were eighteen years of age or younger at the time of histologic diagnosis. Of these young patients, 15, or 54 per cent, had papillary carcinoma; 29 per cent had alveolar and follicular carcinoma; 14 per cent solid carcinoma. One patient was believed to have a Hürthle-cell carcinoma.

Because of the small group of cases, the authors felt unable to correlate accurately the prognosis and histologic type. They feel, however, that the prognosis is poorest in patients with solid carcinoma, and noted that pulmonary metastasis occurred in more patients with alveolar and follicular carcinoma than in patients with papillary carcinoma.

Operative specimens from 10 of the patients were studied with radioautographic technics, and in each instance concentration of radioactive iodine was observed in some portion of the specimen. The authors attribute this high incidence to the fact that this group contained for the most part histologic types found to be receptive to radioiodine.

The initial sign of disease in 10 cases was the appearance of one or more enlarged cervical nodes with no palpable abnormality in the thyroid. Sixteen patients presented both nodules in the thyroid and one or more enlarged nodes. In only one case was thyroid enlargement the only evidence of tumor.

Pulmonary metastasis was present in 13 patients. The appearance of the chest roentgenograms of those children having pulmonary metastasis was found to be a characteristic one, namely, a diffuse miliary to nodular infiltration affecting primarily the basilar portions of the lungs. The roentgenographic appearance of these lung lesions was confused in several cases with tuberculosis and histoplasmosis. No skeletal metastasis was observed in this series. It is interesting to note that 10 of the 28 patients gave a history of irradiation in infancy for "enlargement of the thymus."

Twenty-two of the patients were treated by wide surgical excision of the thyroid and involved nodes. Since postoperative roentgen therapy was employed in only 4 of the surgical cases, the authors are unable to evaluate its place in the treatment of the postoperative patient. The preferred treatment, in their opinion, is early biopsy of suspected cervical nodes and solitary thyroid "adenomas" followed by aggressive therapy, namely, hemithyroidectomy and radical cervical node dissection of the side involved.

Eleven illustrations, including 4 roentgenograms; 4 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Carotid-Internal Jugular Anastomosis in the Rhesus Monkey. Angiographic and Gasometric Studies. E. S. Gurdjian, J. E. Webster, and F. A. Martin. J. Neurosurg. **7:** 467–472, November 1950.

Beck, McKhann, and Belnap have reported upon common carotid internal jugular anastomosis in the neck with ligation of the distal end of the internal jugular vein, as a means of revascularization of the human brain. After the anastomosis, an increase in the blood flow through the head was noted by tracing radioactive material injected into the circulation and by gasometric studies of oxygen in the sagittal sinus before and after a shunt (J. Pediat. **35:** 317, 1949).

In experiments on the rhesus monkey, the authors of the present paper found that, after a carotid-internal jugular shunt, the blood does not flow into the sagittal, straight, or petrosal sinuses for distribution by retrograde flow. Instead, it seeks a ready exit via the neck veins, the basilar veins, and the lateral sinuses. Angiographic studies showed that the shunted flow can be directed into the intracerebral veins by ligation of the opposite lateral sinus and diodrast injection under pressure well above the systolic arterial pressure.

There appeared to be a stagnation of the blood in the sagittal sinus after the shunting, as shown by oxygen determinations. The lowered oxygen values in the sagittal sinus occurred in the presence of elevation of oxygen content of the neck veins.

Nine roentgenograms; 1 table.

HOWARD L. STEINBACH, M.D.
University of California

Irritating Effect of Iodized Vegetable Oils on the Brain and Spinal Cord When Divided Into Small Particles. Rudolph Jaeger. Arch. Neurol. & Psychiat. **64:** 715–719, November 1950.

The author reports the result of injecting highly emulsified iodized oils into the spinal subarachnoid space, the cisterna magna, and the ventricles of dogs. Lipiodol, iodochloral, and iodized corn oil in the usual form produced no reaction. However, when these same oils were emulsified and injected, the dogs became violently ill and seldom lived longer than two weeks. Autopsy revealed marked inflammatory granulations and exudate. Emulsified pantopaque was even more toxic, causing death in ten minutes.

The only explanation offered for the effect of the emulsified oils is that the particles are small enough to pass through the channels of exit from the subarachnoid spaces.

Since blood serum is an effective emulsifying agent, it is reasoned that a mixture of iodized oil with bloody spinal fluid may result in dispersion of the oil in tiny droplets. Iodized oils, therefore, should be instilled into the subarachnoid space with due regard for their irritating properties, and should be removed as completely as possible either before or immediately after surgery.

Two illustrations.

PAUL W. ROMAN, M.D.
Baltimore, Md.

THE CHEST

Asymptomatic and Circumscribed Lesions of the Chest. Walter F. Bugden. Am. Rev. Tuberc. **62:** 512–517, November 1950.

Intrathoracic lesions which are not causing symptoms and those which appear circumscribed on the chest roentgenogram are in more than half of the cases ultimately shown to be malignant. Even those conditions which are benign in the usual sense of the word may not run a benign course. As a rule, the patient is best served by surgical removal of these unexplained and undiagnosed circumscribed lesions.

The author presents briefly observations in 8 patients whose chest roentgenograms showed "silent" or "round" lesions to illustrate the gamut of pathology which must be considered in differential diagnosis. The final diagnoses were: parasternal hernia; ganglioneuroma of seventh intercostal nerve; squamous-cell carcinoma of the right upper lobe; metastatic adenocarcinoma of the left upper lobe (primary tumor in uterus had been removed five years previously); bronchogenic carcinoma with metastases to heart; squamous-cell carcinoma of right lung; acute, caseous lesion of tuberculosis; bronchogenic cyst.

Nine roentgenograms.

Nontuberculous Diseases of the Chest. L. L. Allen. Wisconsin M. J. **49:** 995–1002, November 1950.

To illustrate the problem involved in the diagnosis of non-tuberculous lesions of the chest, the author cites a number of cases from his own experience, including bronchiectasis, pulmonary changes associated with mitral stenosis, cystic lung abscess, pneumonitis, silicosis, blastomycosis and other mycotic lesions, non-tuberculous fibrosis, carcinoma, and syphilis. The fact that all these cases had been previously diagnosed as pulmonary tuberculosis, indicates the importance of *not* relying solely upon the x-ray film, which has robbed many good physicians of their clinical acumen. Special emphasis is placed upon the importance of a careful history and adequate laboratory studies.

Eighteen roentgenograms.

Patterns of Pulmonary Fibrosis as Related to Pulmonary Function. David M. Spain. Ann. Int. Med. **33:** 1150–1163, November 1950.

The author made an analysis of postmortem examinations on a great variety of pulmonary conditions ob-

served over a period of ten years at Bellevue Hospital (New York), from which he concludes that the pattern and distribution of lung fibrosis are more closely correlated with the severity of the clinical manifestations than is the degree of fibrosis. It is the pattern of fibrosis which determines the degree and type of respiratory, ventilatory, combined respiratory and ventilatory, and cardiopulmonary disturbances. In many disease entities several different patterns coexist.

Fibrosis of the lungs may be distributed in five different patterns, namely, bronchial, interstitial, parenchymal, vascular, and pleural. The types of fibrosis observed obviously depend upon the etiologic agents and associated disease processes.

(1) The bronchial tree may become involved in all types of inflammation—acute, chronic, suppurative, non-suppurative, etc. If the inflammatory process is suppurative, destruction of the bronchiolar and bronchial walls may take place, followed by dilatation and fibrosis of the bronchioles. With a mild chronic inflammatory process, the fibrous tissue may be deposited within or around the walls of the bronchioles, either narrowing the lumen or imparting a rigidity to the wall. The main sequela of this type of fibrosis is obstructive emphysema.

Tuberculosis may produce any pattern of fibrosis; most often several patterns coexist.

(2) A second pattern of pulmonary fibrosis occurs in the interstitial tissues of the alveolar septa. In this type of fibrosis, the functional changes are directly related to the thickening of the alveolar wall and the separation of the capillaries in the alveolar septa from the alveolar interface by inflammation, edema, and fibrous tissue. Hence, the disturbance is essentially respiratory rather than ventilatory in nature. Interference with the diffusion of carbon dioxide and oxygen results. The resultant anoxia, in addition to exerting a harmful effect systemically, may specifically injure the myocardium.

(3) Fibrosis of the parenchyma (intra-alveolar) is perhaps the most frequent type of pulmonary fibrosis. The area of involvement may vary from a few alveoli to an entire lobe or more. The process may be localized or diffuse. Tuberculosis, suppurative pneumonia, Friedländer's bacillus pneumonia, pneumonia secondary to inhalation of foreign lipoid, and radiation injury are some of the underlying etiologic agents. The fibrous tissue involves the area to such an extent that it is no longer a functioning unit. The important associated secondary change is distention emphysema.

(4) Fibrosis of the pulmonary vascular bed is another form. This will produce some degree of pulmonary hypertension and, to some extent, impair the nutrition of the lung and produce diffusion disturbances.

(5) The fifth form of fibrosis is related to the pleura. This may result from organization of an exudate secondary to acute and chronic pyogenic empyema, tuberculous empyema, or trauma with blood in the pleural space. This eventually interferes with both the ventilatory capacity of the lung and also with the flow of blood through the involved area. The secondary effect is development of distention emphysema in the uninvolved portions or in the contralateral lung.

[An excellent article displaying a clear understanding of the physiological basis of roentgen signs.—S. N. T.]

One schematic drawing; 4 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Technic, Indications, and Results of Bronchography with a Water-Soluble Viscous Contrast Medium (Joduron "B"). S. K. Fischer. Schweiz. med. Wchnschr. **80**: 723–734, July 15, 1950. (In German)

After a brief historical summary of attempts to obtain adequate viscosity with water-soluble media, the author states that he considers Joduron "B" quite satisfactory. He has used it in over 500 cases since 1948.

Water-soluble materials cause a greater cough reflex than iodized oils, and more thorough anesthetization is required. For premedication, sodium pentobarbital is used, followed after a quarter of an hour by the injection of atropine and dicodid subcutaneously. Local anesthesia is carried out by spraying the pharynx, fauces, and laryngeal area with pantocain. More recently this has been combined with xylocain, a new Swedish preparation which is less toxic.

The author is decidedly against cricothyroid puncture and deprecates the practice of many workers who introduce the contrast material blindly. With the patient in a sitting position, he introduces a Metras catheter, guiding it past the larynx and part way into the trachea. The patient is then placed horizontally, holding the catheter with the lips, and rotated toward the side to be investigated. A few more cubic centimeters of the anesthetic mixture is used, 1 to 1.5 c.c. directed into the upper lobe bronchus with the table in Trendelenburg position, and 5 to 6 c.c. directed into the middle and lower bronchi. The catheter is then partially withdrawn and reintroduced into the upper lobe bronchus or whichever division is to be investigated, and the opaque material is slowly injected. The author stresses slowness of injection so that the medium will not be regurgitated and overflow to the opposite side, inducing a cough reflex.

The author limits the examination to one side at a sitting, and prefers, when possible, to investigate one lobe or segment. In difficult cases, or those in which the patient does not respond to the anesthetic in the usual manner, he will increase local anesthetization by xylocain. He does not hesitate to use double the average amount of anesthetic in difficult cases (silicosis, chronic bronchitis, etc.). In the occasional case where pantocain sensitivity may be present, he has used xylocain alone.

The entire procedure, except for the initial spraying of the throat and larynx, is carried out under fluoroscopic control, the contrast substance is allowed to progress slowly into the finer divisions, and is aided by deep respiration, progressing further into the finer branches on each inspiration. With good teamwork, the entire procedure should be completed in fifteen to twenty minutes, including the anesthesia.

The paper closes with an anatomical description of the segmental bronchial distribution and notes on the value and indications of the procedure, which are well understood in this country.

Thirty-three roentgenograms; 3 drawings.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Pulmonary Calcification—Tuberculosis?, Histoplasmosis? Frederic N. Silverman. Am. J. Roentgenol. **64**: 747–764, November 1950.

This paper is largely in the nature of a review of histoplasmosis. Histories of 4 probable cases with recovery are included.

Histoplasmosis was first described in 1906 by Darling. It was not until 1934, however, that De Monbreun conclusively identified the organism as a fungus. This occurs in two forms: a yeast-like form, which is the pathogenic phase, and a mycelial or filamentous form, which is presumed to be the form found in nature.

The source of human infection has not been demonstrated. Interpersonal infection, though not impossible, would seem relatively unimportant according to studies of incidence of infection in siblings. *Histoplasma capsulatum* has been found occurring naturally in dogs, rats, mice, ferrets, horses, and skunks. It has recently been discovered in the soil. Observations seem to indicate that it has an independent saprophytic existence in nature.

Historically, the disease is a recent one. It has been recognized for the past twenty years that many people with demonstrable intrathoracic calcification do not react to tuberculin. A suggested explanation of this was the possibility of reversal or loss of tuberculin sensitivity. In certain areas, however, the number of individuals with intrathoracic calcification was too great to be explained by the loss of tuberculin sensitivity. Therefore, the possibility of an agent other than the tubercle bacillus as the cause of the calcification was suggested. In support of this was the role of *Coccidioides immitis* in the production of pulmonary lesions. Smith *et al.* (Am. J. Pub. Health **39**: 722, 1949) recently published observations of Furcolow and Nelson which indicate that, as early as 1940, a fungus other than *Coccidioides immitis* was suspected as the cause of pulmonary calcification in tuberculin-negative children in Ohio. In 1943, Smith first suggested the possibility of *Histoplasma* as a specific agent (M. Clin. North America **27**: 790, 1943).

Meantime, studies on the geographic distribution of pulmonary calcification showed a striking correspondence to the endemic areas of histoplasmosis. In 1945 Christie and Peterson (Am. J. Pub. Health **35**: 1131, 1945) found that approximately three-fourths of the children they examined in Tennessee gave a positive reaction to histoplasmin while the rest were tuberculin-positive. They showed that 43.6 per cent had intrathoracic calcification and of these the number positive to the histoplasmin test as compared with the tuberculin test was three to one. Studies by Palmer (Pub. Health Rep. **60**: 513, 1945) on student nurses supported the findings of the earlier observers.

More recent observations have gone far toward establishing, along with the fatal type of disease, a benign form. These studies are divided into three parts:

(1) *Geographic Distribution:* Many studies have been made which confirm the original geographic distribution. The incidence of calcification and a positive histoplasmin test increases with age. However, in females the incidence drops off after the second decade. The incidence is greater among rural than urban residents. Racial factors are less important.

(2) *Laboratory Procedures; Skin Tests:* Much progress has been made with respect to culturing of the organism. The histoplasmin skin test has been extensively studied and found to have a degree of specificity that cannot be denied. Two types of serologic tests are now under study in several parts of the country, namely complement-fixation and agglutination tests.

(3) *Clinical and Roentgen Features of Benign Histoplasmosis:* Reports are beginning to appear of verified benign cases which go on to calcification. The non-specificity of the roentgen findings has been stressed; errors in roentgen diagnosis have been discussed which indicate that etiologic diagnosis is not a strong point of roentgen examination. The mulberry type of pulmonary calcification is discussed, with the conclusion that it is not diagnostic of histoplasmosis, though it has been found frequently in association with a positive histoplasmin test.

Thirty roentgenograms; 2 photomicrographs; 3 photographs.

NELSON E. KLAMM, M.D.
Cleveland City Hospital

Importance of Bronchial Changes Caused by Tuberculous Bronchial Nodes During the Course of Tuberculosis in Childhood. H. Wissler. Schweiz. med. Wchnschr. **80**: 831–836, Aug. 12, 1950. (In German)

The author states that knowledge of the anatomy and nomenclature of the bronchial divisions and corresponding lung segments is extremely important; he follows the nomenclature of the English authors Brock and Foster-Carter (see Foster-Carter and Hoyle: Dis. of Chest **11**: 511, 1945. Abst. in Radiology **47**: 419, 1946). He uses bronchoscopy, bronchography, and tomography extensively in correlation with the usual x-ray studies and clinical findings in individual cases.

Tuberculous nodes may influence a neighboring bronchus by (1) compression (especially in young children), (2) erosion, or (3) perforation. Occasionally direct bronchoscopy may demonstrate the lesions, but in the majority of cases indirect evidence must be relied on. When perforation occurs, it is indicated by (*a*) the general symptom complex, (*b*) signs of bronchial stenosis, (*c*) roentgenographic changes within the lung tissues. The cough is characteristically dry, often coming in attacks similar to whooping cough, occasionally with slight hemoptysis or expectoration of cheesy particles. On fluoroscopy there may be found a difference in diaphragmatic excursion on the two sides, or mediastinal traction with respiration. Increased translucency may be present rather than atelectasis due to obstructive emphysema. Spreading of the infection undoubtedly in some cases follows the primary complex, through fistula formation from the involved node directly into the neighboring bronchus, resulting in progressive extension of tuberculosis throughout the lung or segment, bronchiectasis, or chronic fibroid induration. The author considers some cases of so-called epituberculosis as really atelectasis, especially when they have a relatively benign and short course.

From the above evidence it may be seen that bronchial node infection plays a most important role in childhood tuberculosis, not only through compression, but also through perforation with spreading of the infection and resulting sequelae.

Seven roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Pulmonary Tuberculomas: Pathogenesis, Diagnosis, and Management. Gordon J. Culver, Joseph P. Concannon, and Joseph E. MacManus. J. Thoracic Surg. **20**: 798–818, November 1950.

A tuberculoma is a tumor-like granuloma caused by the tubercle bacillus, encapsulated by connective tissue and showing no evidence of surrounding inflammation or spread. Pulmonary tuberculomas may arise from the encapsulation of a giant primary focus, or of a restricted, rapidly regressive reinfection focus which be-

comes homogeneous, or from the complete blocking of a tuberculous cavity with resultant inspissation of caseous material, fibrosis, calcification, and shrinkage.

Tuberculomas must be differentiated from hamartoma, primary and secondary neoplasms (especially prostatic, testicular, and renal), cysts, abscesses, arteriovenous aneurysms, encapsulated effusions, localized pneumonitis, and other conditions [histoplasmosis and blastomycosis are mentioned by one of the discussants of the paper]. A benign mediastinal tumor may occasionally be forced out into the lung field by negative pressure.

The solitary circumscribed shadow of the tuberculoma is readily confused with the peripheral type of pulmonary carcinoma, especially in the absence of calcification. Calcification is not characteristic of primary pulmonary neoplasms. In tuberculomas it may occur in various forms: it may be so complete as to cause the lesion to resemble a mulberry or it may be present in single or multiple concentric rings or as discrete scattered areas. Other roentgenographic features which suggest tuberculoma are multiple areas of diminished density representing areas of caseation and adjacent areas of calcification and fibrosis.

A tuberculoma is oval, round or lobulated, and well defined. The asymptomatic patient with a solitary, well circumscribed pulmonary nodule of this type should be carefully studied by fluoroscopy, multiple films, planigraphy, bronchoscopy, and aspiration, with examination of pleural fluid if present. Enlarged peripheral nodes call for biopsy. Bronchial secretions should be studied for tubercle bacilli microscopically and *in vivo*, and should be examined by the Papanicolaou technic for neoplastic cells. A tuberculin test is always indicated.

Tuberculomas may be classified on the basis of calcification. Those without calcification call for surgery, not only because of the difficulty of distinguishing them from carcinoma, as mentioned above, but because they are likely to break down, with spread of infection to adjacent lung tissue. Surgical removal is also recommended for calcified tuberculomas with central areas of radiolucency, since they may act as a focus of a spreading tuberculous process. In the absence of central areas of radiolucency in a calcified lesion, an asymptomatic patient with negative sputum should be followed for a long period by serial roentgenograms. In this latter group surgical intervention may lead to tuberculous complications.

Eleven illustrative cases are reported.

Twenty-eight roentgenograms; 3 photographs.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Studies on the Reliability of Mass X-Ray Surveys. L. H. Garland. Irish J. M. Sc., November 1950, pp. 489–494.

Radiologists should be familiar with a factor of error in mass survey interpretations of the chest. A reader may be inconsistent with other readers (interindividual variation), and he may be inconsistent with himself on two separate readings of the same films (intraindividual variation). Controlled experiments indicate that the interindividual variation is from 5 to 24 per cent, while the intraindividual variation is from 3 to 31 per cent. The degree of survey error can be reduced by several methods, notably the following: (1) careful selection of readers; (2) use of dual readings, either by two individuals or by the same individual on two separate occasions; (3) avoidance of undue reader fatigue and eyestrain; (4) expert supervision of film quality.

The discovery of new cases of tuberculosis is useful only if the patients are followed. There is some evidence to indicate that the gradual continuous local survey, with proper follow-up, is more reliable and efficient than the intense surveys now being done in some areas.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Mass Surveys as Case-Finding Techniques for Pulmonary Neoplasms. Katharine R. Boucot. Am. Rev. Tuberc. **62**: 501–511, November 1950.

The mass roentgenographic survey was originally designed for tuberculosis case-finding. In the early period there was no systematic follow-up. In the next period, follow-up was routine and meticulous in cases of possible tuberculosis but absent in cases of possible cancer. At present tuberculosis and neoplasm are emphasized equally.

The purpose of the present paper is to illustrate the various categories utilized in interpretation of photofluorograms by the Philadelphia Tuberculosis and Health Association and to present some of the results as well as certain of the problems encountered.

All photofluorograms are read as "suspect neoplasm" in which there are present parenchymal mass, emphysema suggesting obstruction, mediastinal enlargement, atelectasis, soft infiltration of cavity associated with mediastinal involvement or shift. Typical examples of these categories are given.

In a survey of 40,607 apparently healthy industrial workers between April 1, 1948, and March 31, 1951, the prevalence of neoplasm was 0.14 per cent. Of 18,633 satisfactory photofluorograms exposed at the Central Unit of the Association during that period, 56 (0.30 per cent) were read as "suspect neoplasm." During the subsequent ten to twenty months, a histologic diagnosis of neoplasm was obtained in 16 of these suspects, while 8 additional proved cases were found among those suspected of having tuberculosis. Thus, the prevalence of proved cancer was 0.13 per cent. Three of the growths were metastatic; 1 proved to be leukemia and another Hodgkin's disease. The remaining 19 were primary bronchogenic carcinomas. Of these, only 3 were suitable for resection.

The author emphasizes the importance of checking the lungs of men over forty-five years of age every six months wherever possible, because of the high prevalence of pulmonary cancer in this group.

Fourteen roentgenograms.

Cancer Detected in Surveys. Richard H. Overholt. Am. Rev. Tuberc. **62**: 491–500, November 1950.

It is important in the author's opinion to consider cancer as a by-product of surveys for tuberculosis from the following points of view: (1) to emphasize that cancer has a detectable silent phase, (2) to consider difficulties in sorting out cases of tuberculosis and cancer during their silent phase on the basis of the roentgen findings, (3) to recognize the necessity for streamlining the follow-up to avoid delays in the event of cancer, (4) to indicate steps that may be taken to ensure accuracy of diagnosis.

There are both presumptive and absolute evidence of

the existence and detectability of silent forms of cancer of the lung. In accumulating data on ill cancer patients, it is possible sometimes to obtain for comparison roentgenograms taken at some period antedating symptoms. Some of these have shown an abnormal shadow corresponding in location to the one produced by the known cancer. It is reasonable to assume that the shadows in the early and late films represent the same growth process.

Cancers have also been found upon surgical exploration in asymptomatic individuals. Of 145 patients explored at the Overholt Thoracic Clinic (Boston), 1938 to 1950, for abnormalities discovered in surveys, 51 had lesions which proved to be neoplastic and 35 malignant.

It is not surprising that tumors in their early developmental stage cast shadows on the roentgenogram. The majority of them originate in the larger bronchi, occlude the lumen, and cause segmental or subsegmental atelectasis. The obstructing growth need be but a few millimeters in diameter to produce secondary changes in the peripheral portion of the corresponding segment.

In the event that the cancer has originated in a small bronchus or in a bronchiole, its situation will then be peripheral and in the part of the lung field of greatest contrast. The direct shadow of the tumor will be seen. According to Rigler (J. A. M. A. **142**: 773, 1950. Abst. in Radiology **56**: 287, 1951) shadows of growth as small as 3 mm. in diameter are detectable.

Difficulties experienced in the past in differentiating lung cancer from other conditions are illustrated by experiences at the author's clinic. In the past twelve years, 849 patients suffering from primary carcinoma have been studied. Of this number, 824 had symptoms when observed and had been under medical supervision for an average of approximately six months. The most common erroneous diagnosis was tuberculosis, especially if there were abnormal shadows in the upper half of the lung field. If the shadow was in the lower lung field, the most likley diagnosis was given as bronchitis, bronchiectasis, or atypical or virus pneumonia.

It is quite obvious that the earlier in the life history of cancer of the lung detection is made, the more difficult it is to obtain tissue for absolute verification. Additional studies are essential and should progress in the following order until the true diagnosis is settled:

1. Complete roentgen examination, including fluoroscopy, postero-anterior projections, and such supplementary films as are individually indicated. Oblique projections with the patient turned no more than 30° are most helpful. The lateral position, inspiration and expiration films, and laminagrams sometimes offer additional information.
2. Search for tubercle bacilli in sputum and gastric specimens. Negative findings may be used as presumptive evidence of cancer.
3. Cytological examination of sputum or bronchial washings.
4. Bronchoscopy and biopsy if a tumor is visible.
5. Surgical exploration with gross and microscopic examination of the tissue under suspicion.

The four preoperative examinations should be completed in less than a week and should be followed immediately by careful evaluation of all the data. All patients with abnormal shadows which cannot be adequately explained on another basis should have the benefit of surgical exploration.

Ten roentgenograms; 1 drawing; 2 tables.

Role of the Radiologist in the Diagnosis of Bronchogenic Carcinoma. Cesare Gianturco. Illinois M. J. **98**: 243–245, October 1950.

Radiology has definite limitations in the diagnosis of bronchogenic carcinoma. The main ones arise from the fact that in most cases roentgen rays will not show the tumor itself but only the changes which occur in the lung following partial or complete obstruction of the bronchus. The tumor may grow to a considerable size and possibly extend to the hilar nodes before obstructing the air flow enough to give radiological signs. Such tumors may cause hemoptysis, cough, and weight loss, without significant abnormality on the chest film. Such small tumors can be diagnosed by bronchoscopy or bronchography, or cytologically, before the radiologist can detect them on a routine study of the chest.

As the tumor continues to grow, it reaches a size where it *almost* obstructs the lumen of the bronchus and obstructive emphysema develops. For the first time abnormal x-ray changes may be apparent. The emphysematous lung will appear to be better aerated than the remainder of the lung tissue. If the area of emphysema is large enough, there may be displacement of the mediastinal structures toward the opposite side of the chest. Obstructive emphysema is usually of short duration, for the tumor soon grows large enough to obstruct the bronchus completely, producing atelectasis of the distal lung. Atelectasis is usually a late sign of bronchogenic carcinoma; its extent, however, is no indication of the size of the tumor. About 25 per cent of lung carcinomas arise in the periphery of the lung. These tumors may originate from either bronchial or alveolar epithelium. The smaller peripheral tumors produce localized emphysema and later small areas of wedged-shaped atelectasis. Infection of the atelectatic lung plays an important role and in many cases areas of consolidation and abscess cavities develop.

Some tumors may invade the lymphatic pathways in a retrograde fashion, producing localized areas of increased markings or a reticular appearance. Large hilar masses surrounded by clear lung are rarely due to bronchogenic carcinoma. With carcinoma one will usually find some areas of atelectasis or infiltration accompanying the hilar mass.

Since the radiologist is able to make a tentative diagnosis of carcinoma of the lung in only the relatively late cases, it is important that the clinician be sufficiently alert to ask for the proper follow-up study in those cases with definite symptoms and a negative x-ray examination.

Twelve drawings.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Angiocardiopneumography in Diagnosis of Tumors of the Lung and Mediastinum. M. Battezzati, F. Soave and A. Tagliaferro. Schweiz. med. Wchnschr. **80**: 799–802, July 29, 1950. (In German)

Angiocardiography has not only shown rapid development in the diagnosis of congenital cardiac conditions, but the study of the lung vessels has become increasingly valuable in diagnosing the various types of mass lesions in and about the mediastinum, identifying their nature, and differentiating them from aneurysms and other lesions of purely vascular origin. The method used has been essentially that described by Robb and Steinberg with 70 per cent Joduron as contrast medium and a series of 5 films. The patient is always tested for iodine sensitivity and kidney function.

On ordinary fluoroscopy a tumor may appear to pulsate and simulate the characteristics of an aneurysm. On the other hand, an aneurysm may fail to show visible pulsations because of thick walls, blood clot, or fibrotic changes. Differentiation of these two conditions is made possible in most cases by the contrast filling of the vessels.

If the superior vena cava shows change of position or pressure on one side, it indicates that the neoplasm is involving the adjacent lymph nodes and is strong evidence against successful operative intervention. Displacement and stenosis of the pulmonary artery or its branches may be definitely demonstrated. The arterial phase on the affected side can be recognized in the angiocardiogram, while on the sound side the venous phase is visible, clearly indicating delayed circulation on the side of the tumor. These signs differentiate between pulmonary aneurysm and a mass lesion or indicate that secondary node involvement has taken place. A benign tumor may often be differentiated by the fact that it grows more slowly and does not occlude or cause marked pressure on the vessels during the earlier stages. Benign lesions extend between the vessels and displace rather than compress them. A rounded shadow, if associated with arterial displacement or occlusion and evidence of poor circulation in the corresponding lung regions, is strongly suggestive of a malignant growth. Vessel distortion or displacement may often be recognized before the classical signs of bronchial occlusion. In the periphery of the lungs there is very little distortion of the vessels with small tumors; a lateral projection is strongly advised, as sometimes a slight displacement is seen in this view and not recognized in the postero-anterior projection.

Inflammatory processes can often cause appearances similar to those described above but show more normal topography of the vessels and may often be differentiated on that basis.

Nine roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Treatment of Giant Cysts of the Lung. Frank F. Allbritten, Jr., and John Y. Templeton, III. J. Thoracic Surg. **20**: 749–760, November 1950.

A single large cystic lesion of the lung is recognizable roentgenographically as an area of decreased density. Whereas inflammatory lesions have a thickened border, the cyst has a fine border except that compression of adjacent parenchyma may produce diffuse peripheral haziness. Trabeculae within the cyst may produce fine linear shadows across the radiolucent area. Large cysts may require differentiation from tension pneumothorax. In the presence of pneumothorax, the elastic lung will usually contract about the hilus, where it produces a globular shadow. With an expanded cyst ("vanishing lung") the hilar shadow is usually elongated and compressed lung tissue may be found apically or over the diaphragm. A cyst may cause widening of the intercostal spaces as contrasted with narrowing in pneumothorax.

Symptoms vary, depending upon the size of the cyst (extent of compression of healthy, functional lung tissue) and the complications superimposed by infection, hemorrhage, and spontaneous pneumothorax. Cysts which are lined with respiratory epithelium require surgery aimed at removal of the epithelial lining and closure of the bronchiolar openings. For determination of the presence or absence of an epithelial lining, surgical exploration is necessary. Excision of the cyst wall and obliteration of the pleural space by re-expansion of healthy lung, with catheter drainage and suction, is recommended for single large cysts of the lung.

Thirteen roentgenograms.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Surgical Treatment of Giant Emphysematous Blebs and Pulmonary Tension Cysts. David J. Dugan and Paul C. Samson. J. Thoracic Surg. **20**: 729–744, November 1950.

A report is presented of 14 patients having giant emphysematous blebs and pulmonary tension cysts, treated by local excision, segmental resection, and lobectomy.

The two outstanding considerations in the diagnosis and selection of cases for surgery are the symptoms and the roentgenologic appearance. The prospective surgical patient usually presents a history of increasing dyspnea, pain in the chest, and frequent respiratory infections. He may also complain of slight dysphagia, cough, a feeling of pressure in the chest, and general fatigue. Physical examination in general reveals diminution of excursion over the involved area with decreased breath sounds. The roentgen appearance is essential in the diagnosis and is the most important single finding in the localization of the lesions to one or both lungs. The pathologic area appears black and lacking in lung elements. In many instances the roentgenogram gives the impression of a localized pneumothorax, the increased transparency of the lung being due to actual loss of vascular markings. The surrounding lung appears compressed and in those areas the vascular markings are increased. The lesions are for the most part located in the basilar areas, although apical lesions of this type are common. If serial roentgenograms are available, there is usually evidence of progression in size. Lipiodol bronchograms will rule out the possibility of associated bronchiectasis. Bronchography is of further aid in determining the amount of normal lung tissue that can be depended upon for re-expansion as well as to forecast in advance of surgery the type of resection which will be required.

Twelve of the authors' patients showed definite improvement following treatment. The one operative death in the series occurred in the presence of bilateral disease and was due to over-distention of a contralateral bleb. The authors believe this might have been avoided by preoperative decompression of the opposite side.

Uncorrected large emphysematous tension cysts are usually progressive and lethal in infants. In adults, the increasing dyspnea may prove to be an occupational handicap. Modern surgical technic offers benign thoracotomy as a curative as well as a preventive measure before intracavitary suppuration or symptom-producing tension occurs in mild cases.

Eight illustrations, including 12 roentgenograms.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Non-Bacterial Pneumonias. Jerome T. Syverton. Dis. of Chest **18**: 456–477, November 1950.

The causative agents of non-bacterial pneumonias include a variety of microbiologic agents and their products, such as viruses, rickettsia, fungi, protozoa, toxins, and allergens. The roentgenographic and pathological findings, however, show certain essential similarities.

Roentgenographically, lesions are almost regularly demonstrable within the first few days of illness. The inflammatory lesions are variable as to size, type, and location, and are not sharply defined, but merge imperceptibly with the surrounding tissues. The density, which is variable, may remain stationary until resolution occurs or may act as a focus of spread from which peripheral extension occurs. Transitory changes are common; mottled densities may appear and disappear within twenty-four hours. Lesions may be confined to a single lobe or occur in multiple lobes. There is commonly a predilection for the hilar region, with radial extension outward into the peripheral portions of the lung, but other less well defined lesions may be seen in any portion of the lung. These include such changes as multiple small areas of soft diffuse infiltration that increase in size over a period of days to become irregularly confluent; a diffuse, somewhat coarse mottling, indistinguishable from tuberculosis, especially when it involves the apical regions; and circumscribed foci more commonly in the periphery of the lung field, which are less dense than the consolidation of lobar pneumonia or the opacity of a neoplastic process. Atelectasis may occur as a natural alteration in the pathogenesis of the pneumonic process or as a complication. Pathologically the lesion is an interstitial pneumonitis.

Epidemiological, clinical, roentgenographic, and pathologic studies may serve for allocation of a case within the group of non-bacterial pneumonias, but differentiation of the various types from one another and from certain bacterial pneumonias is usually difficult. Separation into etiologic entities must be accomplished by laboratory studies.

Tables are included setting forth the epidemiologic, clinical, and physical findings and other pertinent information, and each of the main groups of non-bacterial pneumonias is considered separately, with emphasis upon the salient features: influenza, the psittacosis-lymphogranuloma venereum subgroup, primary atypical pneumonia, and a miscellaneous group comprising the other entities.

Eight tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Suppurative Pneumonia. Howard Nicholson. Lancet **2**: 549–554, Nov. 18, 1950. Ibid. 605–611, Nov. 25, 1950.

By the term "suppurative pneumonia" the author means an inflammatory consolidation of the lung which proceeds in whole or in part to suppuration. This can occur in the course of certain specific pneumonias. In a large group of cases of suppurative disease of the lungs, however, organisms of a mixture of types are recovered, none of which is regarded as having invasive properties for the normal lung, and many of which are found in the normal upper respiratory tract.

After a brief discussion of the specific pneumonias (pneumococcal pneumonia, staphylococcal pneumonia, Friedländer's pneumonia, micro-aerophilic non-hemolytic streptococcal pneumonia, and pneumonia due to other specific infections) and the relationship of bronchial cancer to pulmonary suppuration, the author turns his attention to those cases in which specific etiological factors are not found. He advances the view that there is a whole range of aspiration pneumonias of varying severity in which suppuration occurs. One type when first observed presents as a solitary abscess cavity with a little surrounding pneumonia; another as a predominantly pneumonic process in which large or small abscesses may develop. It is important to recognize the solitary abscess because it may sometimes be treated successfully by surgical drainage.

During the period 1946–1948, 57 patients with chronic non-specific suppurative pneumonia were seen at the Brompton Hospital, London. From this group 28 cases were selected in which the course of the disease had been followed long enough for an adequate study of the clinical features. These cases are compared with 25 cases seen by the author in a military thoracic unit in the Middle East in 1941–1945. All the patients in the first group were seen after the disease had been present for some time; in 19 of the 28 cases a cause for the pulmonary suppuration was found, dental sepsis, extraction of teeth, etc. The men in military service were seen early in the course of their illness.

Clinically, the progress of the disease was similar in the two groups of patients. The fever at the onset settled, but was followed by repeated febrile periods, often associated with reduction in sputum. Occasionally the temperature would reach 101° F. Then, often after sudden expectoration of profuse sputum, the temperature would fall to normal. All patients coughed throughout the course of their illness. Hemoptysis was observed fairly often. Clubbing of the fingers was seen in a high proportion of the cases.

Observations on the early military group and the more advanced cases from Brompton Hospital made possible a study of the development and progress of the radiologic changes. All but 3 of the patients in the military group had roentgenograms taken early enough to demonstrate the original distribution of the lesions. In 5, a cavity was visualized within three weeks of the onset of the illness. In these patients the illness began acutely with cough, profuse sputum, and pain in the chest—the onset typical of an acute solitary lung abscess. Abscesses tended to occur most frequently in the posterior and axillary parts of the posterolateral segments of the upper lobes. A large proportion of such cases do not, however, show cavitation at the onset, but consolidation only. This is often segmental, but is not always confined to a single bronchopulmonary segment. Of the 25 patients in military service, 7 showed involvement of a whole lobe and 1 of the whole lung; 2 had pneumonic areas scattered throughout a lobe. In the remaining 12 the lesion was clearly segmental at the onset, whether or not the consolidation broke down early to form an abscess.

The subsequent roentgen picture varied. Usually the disease spread, apparently directly, into the surrounding lung. This extension was not hindered by the interlobar septa. In 7 patients in each series, spread occurred to parts of the same lobe or lung which were not contiguous. Cavitation may take place at any stage of the disease; it may develop early or late in the original lesion, and may sometimes disappear. The radiologic appearance may remain stationary for two to three months; this was commonly associated with clinical improvement. Sooner or later there was usually recrudescence of symptoms, associated with roentgen evidence of further spread of the disease.

In most instances there was some evidence of partial clearing of the pneumonic process. When this occurred, the lung showed roentgenologic signs of fibrosis. In 9 cases in the combined series, roentgen examination, after recurrent episodes of consolidation and cavitation, revealed only fibrosis and distortion of the lung. This

is a stage to which the term "burnt-out" is sometimes applied, but in the author's experience, it is not uncommon to see the disease flare up again. Bronchography in the fibrotic stage may show distortion of the bronchial tree and bronchiectasis of any type. In the active phase of the disease, bronchograms are of no value since the iodized oil rarely enters the affected parts of the lung. In 2 patients empyema developed one year and four years, respectively, after the onset of the pulmonary suppuration.

Illustrative cases are presented, and treatment and the pathologic changes are discussed.

Forty-one illustrations, including 37 roentgenograms.

Acute Primary Klebsiella Pneumonia. Maurice Nataro, David Shapiro, and Armond T. Gordon. J. A. M. A. **144**: 12–16, Sept. 2, 1950.

After reviewing the pertinent literature on the treatment with streptomycin of acute primary pneumonia due to *Klebsiella pneumoniae* (Friedländer's bacillus), the authors report 5 cases, 4 treated with streptomycin and 1 with aureomycin. Regardless of how long after the onset of the disease treatment with streptomycin was started, the drug was found to be highly effective in either curing the infection or greatly reducing the incidence of the chronic phase. In the one case in which aureomycin hydrochloride was used, the results were dramatic, suggesting that further clinical trial and evaluation are indicated.

The authors believe that the radiologist can be of definite aid in arriving at an early diagnosis, principally by having a high index of suspicion in all cases in which there is massive, dense, and usually homogeneous lobar consolidation, particularly when there is bulging of the fissure. They do not think that the degree of radiopacification of the involved lung is of any diagnostic significance, as similar densities may be found in other forms of pneumonia with a comparable extent of disease.

The tendency for early development of abscesses and subsequent cavitation has been stressed. The authors, however, caution against the reporting of circular areas of partial clearing with resultant relative radiolucency and/or temporary areas of obstructive or compensatory emphysema as cavities. In this regard there are probably frequent errors of commission because of anticipation of the well recognized and not infrequent complication of cavity formation.

In the present series, the fact that definite evidence of cavity formation was not apparent in any instance suggests that early treatment with streptomycin or aureomycin will reduce the incidence of cavity formation and chronic fibrosis.

Ten roentgenograms; 1 chart.

Occupational Factors in Pulmonary Dust Disease. Gordon C. Smith. M. J. Australia **2**: 777–782, Nov. 25, 1950.

Pneumonoconiosis is defined as follows: "a diagnosable disease of the lungs, produced by the inhalation of dust, the term dust being understood to refer to particulate matter in the solid phase, but excluding living organisms (the term diagnosable indicating the presence of signs or symptoms, but not always loss of function)."

The occupational history is of special importance. Unless there has been an actual exposure to dust of a harmful nature there cannot be a diagnosis of pulmonary dust disease, no matter how strongly the roentgenograms or the clinical symptoms suggest such a disease. Most of the dusts cause pathological changes by their chemical activity. The most injurious component is crystalline free silica and the most harmful particles of siliceous and other mineral dusts (except asbestos) are those less than about 5 microns in diameter. In the case of fibrous dusts, however, such as asbestos and certain vegetable dusts, the larger sizes appear to be the more harmful, acting in the lungs as mechanical rather than chemical irritants.

The usual occupations and dusts associated with the risk of pneumonoconiosis are discussed. In addition to the diseases caused by silica, coal, and asbestos, reference is made to the abnormalities caused by basalt, arc fumes, talc, graphite, cement, zinc, cadmium, beryllium, manganese, iron, aluminum, synthetic abrasives, cotton, bagasse, and wheat.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Atelectasis and Bronchiectasis in Pertussis. A. W. Lees. Brit. M. J. **2**: 1138–1141, Nov. 18, 1950.

Laennec in 1819 reported finding a case of bronchiectasis in a child of three and a half months who had died of whooping cough. He stated that he considered whooping cough to be the most common progenitor of bronchiectasis.

Lander and Davidson showed experimentally that aspiration of viscid material into peripheral parts of the bronchial tree would lead to collapse of the lung and compensatory dilatation of the bronchi of the collapsed area. They found from their experiments that the collapsed lung could re-expand and the dilated bronchi return to normal size (reversible bronchiectasis) or that the bronchi could remain dilated.

In order to determine the incidence of bronchiectasis in whooping cough, 150 consecutive cases of this disease seen in Ruchill Hospital, Glasgow, were followed by clinical examination and weekly roentgen examination of the chest. In patients more than a year old, bronchoscopy was done when indicated.

The diagnosis of collapse is sometimes difficult and special views, such as the lateral and lordotic, may be necessary for differentiation from pneumonic consolidation.

Of the 150 cases studied, 65 cases, or 43 per cent, showed atelectasis. A total of 85 lobes were involved, separate lobes becoming affected at different times. The left lower lobe was the most common site. It was involved 43 times; the right lower, 31 times; right middle, 8 times; right upper, twice; left upper, once. Of the 85 instances, 60 were slight, 15 moderate, and 10 severe. Atelectasis occurred with increasing frequency until the fourth week of illness after which the incidence declined. In only one case was the onset as late as the eleventh week. The duration was seldom longer than five weeks. It was found that bronchopneumonia was an extremely serious complication of whooping cough and was responsible for most of the deaths early in the disease. The presence of bronchopneumonia did not cause bronchiectasis and was not a factor in its occurrence except where atelectatic areas already had occurred.

Contrary to what was expected, there was no correlation between a rise in temperature and the occurrence of

atelectasis, and none of the children complained of pain in the chest due to atelectasis. Because pulmonary collapse is caused by aspiration of sputum into the peripheral bronchi, postural drainage and rolling the patient about, as advocated by Sante, were tried and the collapse often cleared up. Inhalation of carbon dioxide has been advocated and bronchoscopic aspiration was tried with indifferent success. In 4 cases artificial pneumothorax was instituted, but the results were not conclusive. How long an atelectatic bronchiectasis may be present and still be reversible is not known, but the presence of infection is doubtless the main factor militating against recovery.

In this series of cases the incidence of bronchiectasis was very low, and in all but one the condition was reversible.

From these studies the importance of pulmonary collapse as a complication of whooping cough seems obvious. Atelectasis in many cases can be recognized only by the x-ray, and roentgen studies should always be done before supervision of the case ceases. It still is not widely appreciated that recurrent attacks of "pneumonia" and persistent localized crepitation call for bronchography before copious sputum and clubbing of the fingers make their appearance. Every effort should be made to promote the expansion of the affected lung. If dilatation of the bronchi remains longer than a year after re-expansion, surgical removal of the affected lobe should be considered.

Three tables.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

Protean Nature of Scleroderma—With a Note on Pulmonary Changes. Stanley M. Aronson and Lazar Wallerstein. New York State J. Med. **50:** 2723–2726, Nov. 15, 1950.

The etiology of scleroderma remains obscure. The diffuse and changing involvement of many of the internal viscera, such as the heart, lungs, and gastrointestinal tract, may cause great difficulty in diagnosis.

A case is reported of a patient who was followed for nineteen years, with clinical and roentgenographic findings at various times resembling pulmonary tuberculosis, carcinoma of the stomach, and chronic ulcerative colitis. A diffuse honeycomb pattern of small cysts throughout the lower lung fields was of particular interest. Autopsy revealed a loss of alveolar structure, with replacement by coarse strands of relatively acellular fibrous tissue, with an increase in elastic fibers in these zones. These findings reduplicate changes previously described in visceral scleroderma (Getzowa: Arch. Path. **40:** 99, 1945).

The authors believe that the honeycombing phenomenon represents the radiographic counterpart of cystic pulmonary sclerosis, and that this finding may, with further corroborative evidence, come to be considered pathognomonic.

One roentgenogram; 1 photograph; 4 photomicrographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N.Y.

Pulmonary Cavitation Due to Polyarteritis. Benjamin P. Sandler, James H. Matthews, and Siegbert Bornstein. J. A. M. A. **144:** 754–757, Oct. 28, 1950.

The authors report here a case of polyarteritis with roentgen evidence of multiple pulmonary cavitation.

A 39-year-old white male was admitted to the hospital with signs and symptoms of pulmonary disease. He ran a subacute febrile course with increasing secondary anemia, anorexia, and weight loss. During his hospitalization he had signs of pulmonary disease, nephritis, hypertension, migratory arthritis, and gastro-intestinal disease. He did not respond to chemotherapy or other forms of treatment and died in uremia five months later.

Chest films obtained over this period showed patchy densities in both lung fields which later enlarged and showed excavation. One of these lesions was seen to regress over the five-month period. The final roentgenograms revealed diffuse parenchymal abnormality with multiple cavities.

Periarteritis nodosa or polyarteritis is a disease of unknown etiology, on a probable allergic basis. The authors' review of the literature showed involvement of the lungs in 27 per cent of the cases reported, but only 1 other example of pulmonary cavitation, found at autopsy but not demonstrated roentgenographically (Sweeney and Gabbenstose: Proc. Staff. Meet., Mayo Clinic **24:** 35, Jan. 19, 1949). The pathological basis for the pulmonary cavitation is extensive infarction. This infarction type of necrosis was confirmed in the authors' case by thoracotomy.

The advisability of considering polyarteritis as the possible cause of pulmonary cavitation in cases of obscure origin is pointed out.

Three roentgenograms; 2 photographs; 2 photomicrographs.

O. W. DOYLE, M.D.
University of Michigan

Laminagraphy Associated with Artificial Anterior Pneumomediastinum in the Roentgen Study of the Mediastinum. Attilio Romanini and Mario Spadoni. Ann. radiol. diag. **22:** 459–464, 1950. (In Italian)

Anterior pneumomediastinum consists in the introduction of gas into the anterior mediastinal space according to the technic first described by Condorelli (meeting of the Italian Society of Internal Medicine, 1947). This procedure establishes gaseous contrast about the structures of the anterior mediastinum and especially the thymus. The authors have combined the injection of air with laminagraphic studies and present a case of thymic hypertrophy in a child eight years of age, first studied by ordinary radiography and fluoroscopy and then with a laminagraph taken after the introduction of air in the anterior mediastinal space. The laminagraphs showed a hypertrophic thymus.

Eight roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Electrokymographic Studies of Abnormal Left Ventricular Pulsations. John B. Schwedel, Philip Samet, and Henry Mednick. Am. Heart J. **40:** 410–429, September 1950.

The authors have studied the incidence of paradoxical pulsations both fluoroscopically and electrokymographically in 31 cases of anterior myocardial infarction, 28 cases of posterior wall infarction, and 11 cases of combined anterior and posterior wall infarction. The diagnoses were supported by the history, physical examination, laboratory observations, clinical course, and electrocardiograms. In most of the cases 12 leads were recorded, including the 3 standard, 3 unipolar limb leads, and 6 unipolar chest leads with a Wilson ter-

minus. At times further exploratory unipolar chest leads were recorded. Five additional cases were studied in which the clinical course suggested myocardial infarction but the pattern was obscured by the presence of left bundle branch block. In all 75 cases, the electrokymographic studies were obtained at least six weeks after the supposedly acute infarction.

Simultaneous electrokymography was employed. In this manner at least six points in the left ventricle were studied in each of three positions, postero-anterior and right and left anterior oblique, two points being recorded simultaneously. The tracings were recorded on a three-channel direct-writing Technicon. Two channels were utilized to record the electrokymographic tracings. The carotid artery pulse wave or the electrocardiogram was recorded on the third channel. There is a time lag of 0.03 second on the carotid artery pulse wave compared to the ventricular electrokymogram, which must be taken into consideration when comparing corresponding points on the two. The electrokymographic curves were recorded at a paper speed of 25 mm. per second.

The data were analyzed for the incidence of abnormal, especially paradoxical, pulsations noted fluoroscopically and electrokymographically, and for types of abnormal pulsations noted on the electrokymograph. An attempt was made to correlate the incidence of abnormal pulsations as determined by the two procedures and also to correlate the site of infarction as determined electrocardiographically with that indicated by the electrokymogram.

Of the 31 cases of anterior myocardial infarction, 19 showed paradoxical pulsations fluoroscopically in the postero-anterior position. All of the 19 also showed paradoxical pulsations electrokymographically, as well as 3 of the remaining 12. The electrocardiogram and electrokymogram showed correlation in all cases.

Of the 28 cases of posterior wall myocardial infarction, 17 showed paradoxical pulsations on fluoroscopy, and in all of these paradoxical pulsations were evident electrokymographically. Of the 11 showing no paradoxical pulsations on fluoroscopy, 7 showed none on the electrokymogram, while in the remaining 4 paradoxical pulsations were demonstrated in either the postero-anterior or left anterior oblique position. There was a lack of correlation between the electrocardiogram and electrokymographic picture in 12 of the 28 cases with posterior myocardial infarctions.

Three of the 11 cases of combined anterior and posterior myocardial infarction showed comparable findings on fluoroscopy, electrokymography, and electrocardiography. In the remaining 8 cases paradoxical pulsations were noted only in the postero-anterior position on fluoroscopy. Two of these 8 cases showed a correlation between the electrokymogram and electrocardiogram in both the postero-anterior and left oblique positions, while the other 6 showed correlation only in the postero-anterior position.

In 10 cases with marked cardiac enlargement but without evidence of myocardial infarction in the history, physical findings, or electrocardiograms, paradoxical pulsations were noted in all. In 5 patients with left bundle branch block, the history was suggestive of myocardial infarction but the diagnosis could not be confirmed.

Seven electrocardiograms; 5 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Electrokymographic Studies of the Relation Between the Electrical and Mechanical Events of the Cardiac Cycle in Wolff-Parkinson-White Syndrome. Philip Samet, Henry Mednick, and John B. Schwedel. Am. Heart J. **40**: 430–446, September 1950.

The discovery of the phenomenon of pre-excitation as exemplified by the syndrome of anomalous atrioventricular excitation (Wolff-Parkinson-White syndrome) has produced fertile soil for the study of the relations between electrical and mechanical cardiac asynchronism. The electrocardiographic pattern of this syndrome presents a short P-R interval and a prolonged QRS complex. The concept of an accessory auriculoventricular pathway, the bundle of Kent, represents the most acceptable explanation of this pattern to date. The theory of electrical pre-excitation suggests the possibility of mechanical ventricular asynchronism with the lag in ventricular contraction and ejection on the side opposite the anomalous bundle. The bundle of Kent may be on either the right or left side, and mechanical asynchronism with delay of ejection from either the right or left ventricle is a theoretical possibility if a correlation exists between the electrical and mechanical events of the cardiac cycle.

In order to determine whether electrical asynchronism or pre-excitation would be accompanied by mechanical asynchronism, the authors studied 15 cases of Wolff-Parkinson-White syndrome. Simultaneous electrokymographic tracings were made of the ascending aorta and pulmonary artery in the right anterior oblique position, and at the same time an electrocardiographic tracing was made with a direct-writing Technicon. Previous studies on more than 50 normal subjects showed a variation between the two large vessels from plus 0.03 to minus 0.02 second. That is, the pulmonary artery ejection phase might precede the corresponding ejection phase of the aorta by 0.03 second or follow it by as much as 0.02 second.

The authors divide their cases into two groups, A and B. In Group A the R wave was the sole or largest deflection of the QRS complex in leads from the right side of the precordium, suggesting the pattern of right bundle branch block and a left-sided bundle of Kent. In Group B, the pattern suggested a left bundle branch block and a right-sided bundle of Kent.

In 4 patients in Group A the relationship between the ascending aorta and pulmonary artery was within normal limits, *i.e.*, no correlation between electrical pre-excitation was suggested by the electrocardiogram and mechanical asynchronism. In 3 patients, the ascending upstroke of the aorta preceded that of the pulmonary artery. In Group B, 6 cases showed no asynchronism, and in 2 cases the pulmonary artery was minimally ahead of the ascending aorta. However, even though mechanical asynchronism was found in a total of only 5 cases, the electrokymographic tracings showed delayed mechanical ejection from both sides of the heart in all instances.

Six electrokymographs and electrocardiograms; 3 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

The Ventricular Electrokymogram. L. C. Akman, A. J. Miller, E. N. Silber, J. A. Schack, and L. N. Katz. Circulation **2**: 890–899, December 1950.

Two hundred electrokymographic tracings were taken from the left ventricles of 32 young healthy adults at different sites and in varying positions. Care-

ful study of these shows that the initial enthusiasm for the procedure needs to be tempered somewhat, since curves which had been considered as definitely pathological and even characteristic of certain conditions were found in some of these normal subjects. It was also found that the time relationship of certain points of the ventricular curve with the heart sounds were not completely consistent at different sites along the ventricular border. Further study is required before too much reliance can be placed on the procedure as a tool in diagnosis and research.

Eight electrokymograms; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Correlation of Simultaneously Recorded Electrokymograms and Pressure Pulses of Human Heart and Great Vessels. A Preliminary Report. A. H. Salans, J. A. Schack, and L. N. Katz. Circulation 2: 900–906, December 1950.

Right heart catheterization, with recording of intraluminal and intracavitary pressures, was done simultaneously with electrokymography, electrocardiography, and direct measurement of the brachial arterial pressure, in 6 subjects, including a child with tetralogy of Fallot, a 68-year-old man with arteriosclerotic disease and cor pulmonale, and 4 children subsequently found to be normal.

Electrokymographic deflections obtained from the pulmonary artery and superior vena cava showed a remarkable constancy of time relationships with simultaneous intraluminal pressure curves. The densograms obtained over these areas followed with a somewhat greater variation. Meaningful points on the ventricular electrokymogram were difficult to define. [This is easily explainable on the basis of the complex movements of the heart in systole and diastole, which are taking place in three dimensions while one tries to measure the result in a small slit of one dimension. It may be that further work will determine optimum positions for studying each phase of cardiac physiology.]

In one case included in the study transient right bundle branch block was produced during catheterization. Asynchronism of ventricular ejection during the period of block was demonstrated by electrokymography of the great vessels.

Anyone interested in electrokymography should read this article.

Ten electrokymographic tracings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Aortography in Infants. John D. Keith and Constance Forsyth. Circulation 2: 907–914, December 1950.

The authors have adapted Castellanos' technic of retrograde injection through the brachial artery to the study of the aorta and its branches in infants: 3 to 6 c.c. of 35 per cent diodrast are injected, with serial filming at a rate of three or four exposures per second for two to three seconds.

Twenty-six aortograms were obtained by this method: 13 patients showed no evidence of abnormality; 8 had patent ductus arteriosus and 4 of these were operated upon successfully; 4 had coarctation of the aorta, and 1 persistent truncus arteriosus. The clinical and roentgen findings in the abnormal cases are tabulated.

Excellent aortograms are reproduced with the article, with clear sharp outlines of the opacified vessel. Since no mention is made of complications resulting from ligation, presumably none were encountered.

Four roentgenograms; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Aortic Length: Angiocardiographic Measurements. Charles T. Dotter, Douglas J. Roberts, Jr., and Israel Steinberg. Circulation 2: 915–920, December 1950.

An angiocardiographic study of the thoracic aorta has been made by the authors and their results are presented in (*a*) 84 cases without aortic disease other than arteriosclerosis, (*b*) in 51 cases of syphilitic aortitis, and (*c*) in 26 cases of hypertension.

All of the angiocardiograms were made in the left anterior oblique or lateral projection so as to afford a side view of the thoracic aorta; all were obtained at a 72-inch target distance so as to minimize distortion and enlargement of the aorta and to secure a film comparable to the standard chest film; all were made during suspended deep inspiration. The following four measurements were made: length of thoracic aorta, length of ascending aorta, length of descending aorta and caliber of midascending aorta.

It was apparent from the authors' studies that the normal length of the thoracic aorta covers a fairly wide range. It follows that knowledge of the aortic length in a given instance cannot be expected to be of significant diagnostic value. Age, arteriosclerosis, syphilis, and hypertension all appear to produce aortic elongation and are additive in this respect.

Syphilitic aortitis produces disproportionate elongation and dilatation of the ascending portion of the aorta as compared with arteriosclerosis or hypertension. This fact is of significance in the angiocardiographic diagnosis of syphilitic aortitis.

In the absence of aortic disease other than arteriosclerosis, the length of the thoracic aorta may be roughly predicted from the following formula: length in cm. = $6.76 + 15.86 \log_{10}$ age. A wide variation from this curve occurs normally, the standard deviation from the mean length being ± 5.07.

Two roentgenograms; 4 graphs; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Blood-Pressure Changes During Angiocardiography. Sheila Howarth. Brit. M. J. 2: 1090–1091, Nov. 11, 1950.

Continuous blood-pressure tracings were recorded in 6 cases during angiocardiography with diodone. Only 5 of the patients had an intracardiac shunt but all showed a considerable drop in both systolic and diastolic pressure, beginning in from six to twenty seconds after injection and lasting for varying periods. Control injection of saline caused no change in pressure. The longest interval was in the patient with no shunt, which, together with the range of the interval in the other cases, suggested an effect on the peripheral arterioles, either directly or through the sinoaortic or other reflex mechanism.

Four graphs; 2 tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Calcification of the Left Atrium in Rheumatic Heart Disease. Dennison Young and John B. Schwedel. Am. Heart J. **40:** 771–778, November 1950.

The authors give the histories of 4 cases of rheumatic heart disease with left auricular calcification, including postero-anterior and right and left anterior oblique esophagrams.

In general the following significant features were noted: (1) the identification of predominant left atrial and right ventricular enlargement in a patient with mitral valvular deformity of long standing; (2) the presence of calcifications in the area of the left atrium, especially in the right anterior oblique position anterior to the displaced barium-filled esophagus, and in the left anterior oblique view, where upward enlargement of the left atrium approaches, displaces, or compresses the left main bronchus; (3) the absence of calcified areas elsewhere within the heart shadow that might then suggest a more diffuse distribution of calcareous deposition with just a fortuitous concentration in the region of the left atrium.

Thirteen roentgenograms; 1 photograph.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Nonspecific Benign Pericarditis. William B. Porter, Oscar Clark, and Reno R. Porter. J. A. M. A. **144:** 749–753, Oct. 28, 1950.

The authors advise caution in differentiation between non-specific benign pericarditis and coronary thrombosis, since the prognosis is good in the former while in the latter it is often fatal. They reviewed 219 cases of pericarditis and selected 14 cases in which the symptoms and clinical course were characteristic of the benign form. The diagnosis of coronary occlusion had been made in 8 of these and considered in all of them. All of the patients had pain, fever, friction rub, accelerated sedimentation rate, and abnormal electrocardiograms.

The authors believe that benign pericarditis may be differentiated from coronary occlusion on the following basis:

1. Pain is substernal as in coronary disease but is never seen to radiate down the arm. Accompanying the pain is a severe and deep substernal soreness aggravated by breathing and coughing. This latter symptom is not characteristic of coronary occlusion.

2. Prodromal symptoms of an upper respiratory infection precede the onset of pain.

3. Precordial friction rub accompanies the pain from the onset of the illness. This fact is the most important point in differentiating between benign pericarditis and coronary occlusion, since the friction rub in coronary disease does not appear until twelve to twenty-four hours after the onset of pain. The extent and duration of the friction rub in pericarditis are in marked contrast to the transient nature and local extent of the friction rub in coronary occlusion.

4. Fever accompanies the onset of pain in benign pericarditis; it occurs later in coronary occlusion.

5. Roentgenograms show obvious increase in heart size. The authors believe that this increase is on the basis of effusion rather than due to dilatation, since the clinical status of the patients does not suggest failure.

6. Electrocardiographic changes characteristic of benign pericarditis consist of elevation of the S-T segments with upright T waves.

Four roentgenograms.

O. W. DOYLE, M.D.
University of Michigan

Hodgkin's Granuloma with Pericardial Effusion. An Unusual Case of Hodgkin's Disease Presenting Initially the Signs and Symptoms of Pericarditis With Effusion. James Albert Hagans. Am. Heart J. **40:** 624–629, October 1950.

An unusual case of Hodgkin's disease in a young man is presented. The patient's initial symptoms were cardiac in type and clinical findings strongly suggested the presence of pericarditis with effusion. It was not until several months later, when peripheral lymphadenopathy was noted, that it became obvious that he was suffering from a disease of the lymph nodes. A rather dramatic resolution of the pericardial effusion and regression of the lymphadenopathy took place during and following treatment with nitrogen mustard and radiation therapy. In view of this response and the absence of any other apparent cause for the effusion, it is thought quite probable that the pericardium was involved by the disease process *via* lymphatic routes from the mediastinal lymph nodes.

Three roentgenograms.

Cysts of the Pericardium. Wallis L. Craddock. Am. Heart J. **40:** 619–623, October 1950.

A case of pericardial celomic cyst in a 48-year-old man is reported. The author discusses in general cystic lesions found in the thorax. He stresses particularly the differentiation of pericardial celomic cyst and cystic lymphangioma. [In this connection see Bates and Leaver: Radiology **57:** 330, September 1951.—Ed.]

Two roentgenograms.

Factors Relating to Heart Size in the Intact Animal. W. F. Hamilton, J. W. Remington, and W. F. Hamilton, Jr. Am. J. Physiol. **163:** 260–267, November 1950.

A method has previously been presented for measuring the size of the dog's heart from the x-ray shadow (Am. J. Physiol. **161:** 466, 1950. Abst. in Radiology **57:** 453, 1951), and observations have been reported indicating a very large variation in the size of the heart within the chest of the intact animal, the heart in the same animal varying from 600 c.c./m.^{2} after a large dose of epinephrine to 200 c.c./m.^{2} after severe hemorrhage.

In the present study the net heart size was observed under many different conditions, with the following conclusions. Heart size in intact animals is directly correlated with time of diastole, mean systolic pressure, stroke volume, and work per beat. Physiological and technical variables produce a wide scatter.

Epinephrine infusion produces a slow large heart with high mean systolic pressure, but with diminished stroke volume and work per beat as compared to the heart of the undrugged dog. Vagotomy, with epinephrine infusion or with carotid sinus removal, gives a rapid small heart with high mean systolic pressures and diminished stroke volume and work per beat as compared to untreated dogs. These differences persist with bleeding.

At high normal venous pressures, reflex changes in diastolic time are paralleled by changes in venous pressure and in heart size. At very low venous pressures the heart may be large or small, depending on filling time. At rapid rates, the heart is small and the venous pressure may be high or low depending on venous return.

The most important factor in fixing the diastolic size

of the heart, in the intact animal, is the filling time (heart rate).

Five charts.

THE DIGESTIVE SYSTEM

Idiopathic Dilatation of the Esophagus (Megaesophagus). M. E. Leder. Schweiz. med. Wchnschr. **80**: 891–892, Aug. 26, 1950. (In German)

A case of idiopathic dilatation of the esophagus—megaesophagus—was observed in a 54-year-old man. He had experienced no symptoms referable to the esophagus, roentgen examination being done because of the occurrence of fever, cough, and expectoration three days after an inguinal hernia operation. The picture was typical of megaesophagus, showing a broadening of the mediastinum to the right of the heart, ending superiorly in a small stripe; the lateral border was sharply demarcated, and there was more or less of a double contour throughout the band-like area. Within this area the density was mottled. A barium meal study showed dilatation of the esophagus with angulation and apparent elongation. The stomach filled somewhat slowly, and esophageal emptying was delayed. Esophagoscopy showed the mouth of the esophagus to be displaced to the left; the mucosa was rather pale, and fluid and food remnants persisted: no ulcers were visible.

The etiology of megaesophagus is not always well understood. The following possibilities are suggested: (1) congenital, often in association with other congenital defects, especially patent ductus arteriosus; (2) atony of the walls with secondary cardiospasm, often with exaggerated peristalsis demonstrable fluoroscopically; (3) diaphragmatic spasm (similar to cardiospasm); (4) actual cardiospasm resulting from trauma, psychosis, infection, etc.; (5) changes in the intrinsic muscle plexi or imbalance of the vagosympathetic innervation (apparently proved by autopsy in 10 cases); (6) toxic factors, with direct effect on the nerve endings; (7) avitaminosis, climatic influences, etc.

The prognosis without treatment is always poor. Conservative treatment is directed to the underlying cause. Operation is recommended if other measures fail, a plastic procedure being done on the cardia, often with definite improvement.

Four roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Tracheoesophageal Fistula Unassociated with Atresia or Stenosis: Difficulties in Diagnosis and Suggestions for Greater Accuracy. Hugo M. Cardullo and David L. Berens. New England J. Med. **243**: 853–856, Nov. 30, 1950.

The rarest form of congenital tracheo-esophageal fistula—that unassociated with atresia—is illustrated by a case report (the second unquestioned case reported in the literature, according to the authors). In this form the lumen of the esophagus is normal except for the communication with the trachea. Clinically there are choking and vomiting, with early pneumonia.

The authors used diodrast in an attempt to demonstrate the communication. The opaque solution (2 c.c.) immediately outlined the bronchial tree but the surgical consultant thought it might have been aspirated and requested that lipiodol be used. Lipiodol did not enter the fistula nor could methylene blue be seen entering the trachea at bronchoscopy. The infant died without surgical exploration and at autopsy the fistula was found.

Two roentgenograms; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Anomalies of the Gastrointestinal Tract. A Review of the Literature and Report of Two Unusual Cases. R. Bretney and Aubrey O. Hampton. New England J. Med. **243**: 241–247, Aug. 17, 1950.

Major congenital anomalies of the alimentary tract that produce symptoms are seen almost exclusively in infancy and childhood. The authors, however, report 2 cases in women forty-nine and eighty-nine years of age.

In the first patient an anomaly of the colon resulting in periodic volvulus over a period of many years was identified by barium enema examination. Numerous previous x-ray studies by competent radiologists had been negative. In all probability this was due to failure to take spot films at the point of torsion of the transverse colon during fluoroscopy and also to the omission of post-evacuation films. At operation the right half of the colon was found to be freely movable, completely covered with peritoneum, and without mesenteric attachments, allowing a rotation of the cecum, ascending colon, and terminal 30 cm. of the ileum, which had herniated periodically through an 8-cm. opening in the small bowel mesentery.

At the time of the abnormal rotation a torsion at both the terminal ileum and the midpoint of the transverse colon had resulted, with a hiatus in the small bowel mesentery through which loops of bowel periodically became strangulated. The operative procedure consisted of a resection of the terminal 30 cm. of ileum, the mobile cecum, and the ascending colon, with the establishment of an end-to-side anastomosis of the terminal ileum and the right half of the transverse colon.

In the second patient, the symptoms and signs of acute intestinal obstruction were clearly present. Before operation it was believed that a previously silent neoplasm of the bowel or a mesenteric thrombosis was the most likely cause of the obstruction. Despite doubt of the wisdom of operation because of the patient's advanced age and complicating arteriosclerotic heart disease, it was decided to explore the abdomen. A band was found strangulating about 40 to 45 cm. of small bowel in the mid ileum. After release of this constricting band, the previously absent pulsations in the arterial supply promptly returned, and the dark reddish-black bowel of questionable viability was not resected. It was believed that the patient could not tolerate such a procedure, and there was serious doubt, in any event, of her recovery. The postoperative course, however, was completely uneventful. Two years later the patient was in normal health, with no abdominal symptoms, and was doing all her own housework and going out frequently.

Four roentgenograms; three drawings.

Early Roentgenologic Evaluation in Patients with Upper Gastrointestinal Hemorrhage. Report of 58 Cases. Richard A. Elmer, A. Ashley Rousuck, and J. M. Ryan. Gastroenterology **16**: 552–565, November 1950.

The authors report 58 cases in which x-ray studies were made after upper gastro-intestinal hemorrhage. They feel that such a procedure is warranted—provided it does not produce any increase in bleeding—since it is

well recognized that patients with a typical ulcer history may have varices or those with known cirrhosis may be bleeding from ulcers rather than varices. When a lesion other than the expected one is found, the contemplated surgical management may be altered. A non-palpatory technic is used for the examination, similar to that described earlier by Schatzki (New England J. Med. **235:** 783, 1946. Abst. in Radiology **49:** 515, 1947).

The examinations in the series reported were performed twenty-four to seventy-two hours after admission to the hospital. If severe shock was present or if the patient was receiving fluids intravenously, the examination was deferred. A second examination was made, when possible, ten to fourteen days after bleeding ceased.

In only 2 of the total number of cases was the examination wholly unsatisfactory. A diagnosis of duodenal ulcer was made in 23 cases, gastric ulcer in 10, marginal ulcer in 1, esophageal varices in 4, carcinoma with ulceration in 2, hiatus hernia in 2, and gastritis in 2. In 14 cases the cause for the bleeding was not determined. Surgical and autopsy proof of diagnosis was obtained in 17 of the 58 cases.

Of the patients with duodenal ulcer, 12 showed a niche only, 3 showed a deformed bulb, and 7 showed a combination of niche and deformity. A repeat examination demonstrated healing of the ulcer in 6 cases. Evidence of healing was also obtained in 2 of the cases of gastric ulcer.

It is concluded that early roentgen examination of patients with bleeding from the gastro-intestinal tract yields valuable information and may make possible diagnoses which might be missed were the examination delayed.

Thirty-two roentgenograms.

J. G. LORMAN, M.D.
Indiana University

Diverticula of the Stomach. Gustave Rosenburg. Am. J. Digest. Dis. **17:** 373–377, November 1950.

Diverticula of the gastro-intestinal tract most frequently involve the colon, but they may also occur in the esophagus, stomach, and small bowel. They are not common in the stomach, and, when present, are usually found at the cardio-esophageal junction. The majority of gastric diverticula occur in women past middle age, although the condition is seen in young persons and has even been reported in infancy.

The symptoms include dull dragging epigastric pain, nocturnal distress, periodic pain relieved by food, belching, nausea and vomiting, and massive hemorrhage. The size and position of the diverticulum influence the severity of these manifestations. In the differential diagnosis, diaphragmatic hernia, diverticulum of the esophagus, gastric ulcer, cancer, and Haudek's niche must be considered.

The diagnosis can best be established by roentgenography. A routine gastro-intestinal examination often reveals the diverticulum. If the abnormality is suspected and the routine films are negative, further examination in different positions—horizontal, vertical, or oblique—may lead to the diagnosis. An oblique view may even reveal the pedicle of the cul-de-sac; occasionally a fluid level is demonstrable.

Treatment should be medical unless the symptoms become too severe. It is sometimes difficult or impossible to find the diverticulum at operation and it may be necessary to open the stomach. The newer transthoracic approach makes operation easier in some instances.

The author presents the case of a 40-year-old woman who for years had experienced a heavy feeling in the abdomen, dizzy spells, a foul taste in the mouth, and episodes of nausea and vomiting. Repeated roentgen examinations revealed nothing of significance until a diverticulum was discovered in the cardiac region at the junction with the esophagus. On operation the diverticulum could not be found until the stomach was opened. Examination showed it to have a paper-thin wall, which was inverted and sutured.

Four roentgenograms.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

Benign Gastric Tumors. Franco Perotti. Radiol. med. (Milan) **36:** 918–931, November 1950. (In Italian)

The author presents 20 cases of benign gastric tumors. After studying their roentgenographic appearance, he concluded that, although their benign nature may be suspected, the diagnosis is never certain and that all patients should be given the benefit of surgical exploration and histologic studies.

Ten roentgenograms; 10 drawings.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Co-existence of Duodenal Ulcer with Independent Gastric Carcinoma. Harry J. Epstein and Theodore H. Mendell. Gastroenterology **16:** 602–608, November 1950.

In a study at the Mayo Clinic, Fischer and his associates found a coexistent carcinoma of the stomach in 1 of every 938 duodenal ulcer patients. Their series included 45,000 patients with duodenal ulcer and 13,000 patients with gastric carcinoma seen during a thirty-five year period (Surgery **21:** 168, 1947. Abst. in Radiology **50:** 128, 1948).

The case histories of the 2 patients with coexisting benign duodenal ulcer and carcinoma seen at Mt. Sinai Hospital, Philadelphia, between 1940 and 1950 are presented. During this period 70,000 patients were admitted to the hospital, of whom approximately 300 had duodenal ulcers and 250 had gastric carcinoma. In the records of the Oncologic Hospital in Philadelphia, only 1 case of the coexistence of these lesions was discovered.

Despite the infrequency of the combined duodenal ulcer and gastric cancer, ulcer patients with changing symptoms or intractable symptoms that were once responsive to treatment should be suspected of having gastric carcinoma, and repeated roentgen and gastroscopic studies should be made with this possibility in mind.

Two roentgenograms; 2 photomicrographs.

D. E. VIVIAN, M.D.
Indiana University

Tumor of the Major Duodenal Papilla. Irving Wills, W. Kenneth Jennings, George S. Loquvam, and William O. Russell. Am. J. Surg. **80:** 493–504, November 1950.

Three cases of biliary obstruction limited to the major duodenal papilla are reported. All were originally diagnosed microscopically as carcinoma, but one later was shown to be benign papillitis. Tumor of the papilla is rarely recognized preoperatively, and even at

surgery it is extremely difficult to make an accurate diagnosis. There is no characteristic syndrome. Early intermittent jaundice, colicky or mild pain, fever and chills, nausea, and diarrhea are frequent symptoms, as with biliary obstruction due to other causes.

The physical and laboratory findings may be suggestive, but in many cases exploratory laparotomy must be undertaken. As indicated above, even this may be indecisive. It is in such cases that operative cholangiography has been recommended by Kaijser (Acta med. scandinav. supp. 170, p. 463, 1946). The authors have developed a simple technic for this procedure which has proved of value in ordinary common duct obstruction and they believe it may be of value in obstruction due to tumor, once it is determined that this produces a characteristic outline, as Kaijser maintains. An opening in the duodenum will make possible direct inspection and palpation of the papilla, and will provide opportunity for obtaining tissue for pathologic study.

In an anatomical study of over 100 papillae, one of the most interesting findings was the presence of frequent accessory pancreatic ducts in the duodenal papilla, occurring in packets of small alveoli penetrating smooth muscle bundles of the wall. The authors feel that these may, as in one of their cases, be easily confused microscopically with adenocarcinoma.

Obstruction at the papilla almost always produces chronic inflammatory changes in the head of the pancreas, often leading to an erroneous diagnosis of tumor of the head of the pancreas.

Pancreatoduodenectomy has been advocated for tumor of the papilla, but the authors believe that the rationale of this procedure may be questioned. Although the exact schema of the lymphatics is unknown, it may be assumed from postmortem studies of metastasizing tumors that the preaortic and periportal nodes comprise the first group to receive efferent lymphatics from the terminal choledochus and adjacent duodenum. Moreover, in cases appearing in the literature the liver seems to have been as frequently involved as the pancreas. In neither of the authors' cases was there evidence of local extension or metastases.

In view of these observations and the high mortality associated with pancreatoduodenectomy, the authors advocate local removal of suspicious lesions of the papilla through a transduodenal approach, with repair of the defect or reinsertion of the pancreatic and common bile ducts into the duodenal wall. If a careful pathological examination reveals penetration of the wall by tumor, a secondary radical surgical procedure may be carried out.

Seven illustrations. ROBERT L. RAPHAEL, M.D.
University of Pennsylvania

Transitory Invaginations of the Small Bowel. Bruno Bonomini. Radiol. med. (Milan) **36:** 907–918, November 1950. (In Italian)

The author presents 16 cases of small bowel invagination which disappeared spontaneously or following palpation. He believes that small intestinal invaginations occur frequently and that only occasionally do they persist long enough to give clinical symptoms. Although the radiographic evidence is rather convincing, the lack of operative findings detracts from the value of this work.

Sixteen roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Roentgenologic Demonstration of a Meckel's Diverticulum. E. C. Raffensperger and F. B. Markunas. Gastroenterology **16:** 609–611, November 1950.

The purpose of this paper is to add another case of roentgenologic demonstration of a Meckel's diverticulum to the literature. Five examples previously reported are cited.

In the present instance the diverticulum was demonstrated on two occasions by a small bowel study following a barium meal. The appearance was that of an abnormal loop of bowel about 6 inches long, with the same caliber as the ileum. It retained barium for more than ten hours. The nature of the abnormality was recognized only following operation.

The lesion was successfully removed but evaluation of the patient's symptoms could not be made because of the coexistence of a uterine chorionepithelioma.

Two roentgenograms. D. E. VIVIAN, M.D.
Indiana University

Cancer of the Colon and Its Early Diagnosis. Wendell G. Scott. J. Iowa State M. Soc. **40:** 513–517, November 1950.

Cancer of the colon is the second in frequency of cancers of the gastro-intestinal tract, and forms about 7 per cent of all cancers. About 50 per cent of colonic cancers occur in the rectum and distal sigmoid. About 12 per cent can be felt by digital examination.

The author divides the responsibility for the early detection and diagnosis in cancer of the colon among the patient, examining physician, and radiologist. The *patient* should be taught to seek medical advice for (1) minor changes in bowel habits; (2) blood or mucus in the stool; (3) increasing fatigability; (4) unexplained loss of weight. The *examining physician* should (1) obtain a careful history of the patient's bowel habits, (2) order radiographic examination on even mild suspicion, (3) perform routine digital and proctoscopic examinations in the study of new patients. (4) He should not attribute rectal bleeding to hemorrhoids without a negative proctoscopic and radiographic examination of the bowel. The *radiologist* should (1) perform a digital examination before giving the barium enema; (2) should study the patient fluoroscopically; (3) should take an adequate number of films in all projections; (4) should use air-contrast enemas in doubtful cases; (5) should repeat the examination after a suitable interval if the patient's clinical symptoms persist and earlier examination was negative.

Five illustrations. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y

End-to-End Anastomosis of the Colon Following Resection: A Roentgen Study of Forty-two Cases. Myer Sharpe and Ross Golden. Am. J. Roentgenol. **64:** 769–777, November 1950.

The authors' material consists of 42 patients examined by one or more barium enemas at intervals varying from several weeks to seven years after end-to-end anastomosis of the colon. Resection was performed in 36 of the cases for carcinoma of the colon.

Thirty-nine of the cases (93 per cent) showed some abnormality at the site of the anastomosis at the first examination following operation. A short (1 cm. or less) bilateral constriction without destruction of the mucosal pattern was the most common finding, occurring in 26 cases. Longer bilateral constrictions oc-

curred in 9 cases, and are believed to be due in part to spasm. All but one of the longer constrictions diminished or disappeared with lapse of time, the exception being associated with abdominal carcinomatosis.

Unilateral narrowing at the site of anastomosis was observed in only 4 cases. Three of these were associated with a recurrence of carcinoma and the fourth was due to a local adhesion which was surgically released.

Five illustrative cases are presented.

Ten roentgenograms; 3 tables.

DONALD F. MAURITSON, M.D.
Cleveland City Hospital

Vesicosigmoidal Fistulas Complicating Diverticulitis. Charles W. Mayo and Charles P. Blunt. Surg., Gynec. & Obst. **91**: 612–616, November 1950.

The authors present the results of an investigation of the clinical course, diagnostic methods, and surgical treatment of diverticulitis of the sigmoid complicated by the formation of vesicosigmoidal fistulas. Among 202 cases of proved diverticulitis of the large intestine seen over a ten-year span at the Mayo Clinic, they found 46 (22.8 per cent) vesicosigmoidal fistulas. The ratio of males to females was 5 to 1 (39 cases to 7), indicating that the uterus may act as a barrier to perforation between the sigmoid and the urinary bladder. The patients ranged from twenty-nine to seventy-six years in age (average fifty-two years).

The chief symptoms were referable to the urinary system. They included dysuria, urgency, frequency, pneumaturia, pain in the suprapubic, perineal, or genital region, passage of feces from the urethra, and hematuria. Symptoms of diverticulitis or intestinal obstruction were usually secondary and of later occurrence. The duration of symptoms ranged from three days to eight years (average 16.8 months).

In only 3 of the 38 cases examined proctoscopically was a diagnosis of fistula suggested. A barium enema study led to the diagnosis in 9 of 45 cases, and cystoscopy indicated the presence of a fistula in 28 of 33 cases.

All 46 patients underwent sigmoid resection and all fistulas were verified pathologically. An extraperitoneal resection of the sigmoid with closure of the opening in the bladder was the most frequently used procedure. Resection with end-to-end anastomosis was also done, with or without a preliminary or concomitant colostomy. Three of the 46 patients died in the hospital, 2 of peritonitis.

The authors feel that primary resection of the sigmoid with or without colostomy and closure of the vesical opening will be employed with increasing frequency in the treatment of vesicosigmoidal fistula complicating diverticulitis.

Three roentgenograms; 2 tables.

NORMAN JULES WINSTON, M.D.
University of Pennsylvania

Appendiceal Abscess in a Four Month Old Infant. Maxwell P. Borovsky. Illinois M. J. **98**: 307–310, November 1950.

Appendiceal abscess is rare in early infancy since most infants with appendicitis either do not live long enough for localization of the process or are operated upon before rupture occurs. The author's patient, a girl of four months, was seen after a ten-day illness, with a mass the size of a grapefruit in the right lower quadrant. Roentgen examination showed displacement of the colon to the left and upward. Sympathicoblastoma and Wilms' tumor were possibilities suggested radiologically. Clinically the diagnosis was appendiceal abscess.

Conservative management was carried out for five weeks after the onset, when incision and drainage became necessary. Five months later surgery was undertaken to remove the "blown-out" appendix. Recovery was uneventful.

Three roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radiological Appearances in Pancreatic Cancer. F. Pygott. Brit. J. Radiol. **23**: 656–666, November 1950.

Of 25 proved cases of pancreatic carcinoma in which a barium-meal examination was done, 9 showed no demonstrable abnormality. The other 16 cases are reported.

Roentgen evidence of pancreatic cancer as shown by these cases are: compression or displacement of the cardiac end of the stomach; displacement of the whole stomach, usually to the right or upward, or both; deformity of the greater curvature; pyloric obstruction; deformity of the duodenal cap; enlargement of the duodenal curve; displacement and fixation of the duodenum; obstruction of the duodenum.

While none of these signs is diagnostic, they are suggestive and confirmatory. The presence of any of them should suggest carcinoma of the pancreas.

Fifteen roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Choledocholithiasis. Hugh S. Collett, Harold D. Caylor, and Wallace S. Tirman. Am. J. Surg. **80**: 514–522, November 1950.

In view of the frequent occurrence (12 to 20 per cent) of common duct stones in patients with cholelithiasis and cholecystitis, the following indications for common duct exploration are given: (1) jaundice or a recent history of jaundice; (2) recent history of chills and fever; (3) palpable common duct stones; (4) enlarged common duct; (5) aspiration of muddy, dark bile from the common duct; (6) many small stones in the gallbladder; (7) persistent biliary symptoms following cholecystectomy; (8) x-ray evidence of common duct stones.

Because patients with common duct stones remaining after cholecystectomy continue to have symptoms and because subsequent surgery is difficult and hazardous, an accurate determination of their presence or absence at the time of operation is of great value. Operative cholangiograms with the patient under anesthesia will accomplish this end. Even after careful surgery, stones which have escaped removal may be demonstrated. Removal of such stones may be possible by non-operative methods, but if these fail, operation is necessary.

Four case reports are included to illustrate some of the difficulties encountered in the management of choledocholithiasis. In one case an unusual anomaly of the extrahepatic ducts was found; in another, the common bile duct terminated in a duodenal diverticulum. [This latter case is reported in RADIOLOGY **55**: 72, 1950.—Ed.]

Eleven roentgenograms, accompanied by diagrammatic drawings.

JOHN F. WEIGEN, M.D.
University of Pennsylvania

Pyloric Obstruction by a Cholelith. Report of a Case. Andrew E. Ogden. J. M. Soc. New Jersey **47**: 512–514, November 1950.

A case is reported in which a gallstone eroded into the pylorus and became impacted, causing a sudden onset of vomiting. Examination with barium showed complete pyloric obstruction. Suction and lavage were instituted and a second roentgen examination, six days after the first, showed a large amount of barium to have entered the biliary tree, including the gallbladder, but none in the duodenal loop. At operation the stone was removed, but because of the patient's age and general condition further surgery was not attempted. Four weeks later the stomach was again examined and the fistula was still open. The duodenum was normal and no obstruction was seen. Five months after operation the patient was having no digestive disturbances.

One roentgenogram; 1 photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

An Unusual Case of Gallstone Ileus. I. F. Stein, Jr., and Karl A. Meyer. Illinois M. J. **98**: 254–256, October 1950.

This case of a 47-year-old female, who complained of vomiting, abdominal pain, and no passage of gas or feces for four days, is taken from the records of the Cook County Hospital. The survey film of the abdomen showed a moderate amount of gas but no definite pattern was noted. A barium enema study revealed diverticulosis in the descending and sigmoid colon. The patient was treated conservatively for about one week and continued to show signs of incomplete obstruction. On the ninth day following admission she was given a barium meal by mistake. Twelve hours later signs of complete obstruction developed. Films at the time showed (1) a small diaphragmatic hernia, (2) an irregular filling defect to the right of the first portion of the duodenum, (3) several markedly distended loops of jejunum filled with barium, and (4) complete obstruction of a loop of jejunum on the left side of the abdomen, beyond which no barium had passed.

On exploratory laparotomy, a distended loop of jejunum presented. On the right this led to an area of tuberculous peritonitis. To the left a large gallstone measuring $5 \times 4 \times 3.5$ cm. was found within the lumen. Further examination revealed an inflammatory mass in the region of the gallbladder. It was then realized that the irregular filling defect to the right of the duodenum probably represented barium that had passed through the cholecystoduodenal fistula.

Three roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Surgical Aspects of Scout Films of the Abdomen. C. Melvin Bernhard. J. Kentucky State M. A. **48**: 499–504, November 1950.

A scout film should always precede a roentgen study of any portion of the abdomen. It may be desirous first to rid the intestinal tract of gas and feces but with an "acute abdomen," such preparation may be dangerous, and can be dispensed with.

The author discusses the value of the scout film, especially in relation to a perforated hollow viscus, foreign bodies, intestinal obstruction, disease of urinary and biliary tracts, and with specific reference to the information which can be obtained about the various organs within the abdomen from such a study.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

THE MUSCULOSKELETAL SYSTEM

Differential Diagnosis of Malignant Bone Tumors. Mark B. Coventry. Ann. Surg. **132**: 888–898, November 1950.

The author mentions as among the more recent contributions which are helpful in making a diagnosis of bone tumor: (1) the development and interpretation of the erythrocyte sedimentation rate; (2) the utilization of bone marrow biopsy; (3) studies of tumor cytology and its value in conjunction with needle biopsy; (4) the application of Broders' grading of degree of malignancy; (5) further microscopic differentiation of tumors such as osteoid osteoma, eosinophilic granuloma and reticulum-cell sarcoma.

In making a diagnosis of bone tumor, all factors must be considered, including a carefully taken history, complete physical examination, essential laboratory studies, roentgen findings, and especially surgical biopsy. Even biopsy is not 100 per cent accurate, for the following reasons: (1) The tumor may have been previously irradiated and this irradiation may have caused some change in the structure and appearance of the cells. (2) Previous removal of a specimen for biopsy may have resulted in infection or hemorrhage, or both, which may confuse the microscopic picture. (3) The surgeon may not take a representative section of the tumor or may miss the main substance entirely. (4) The pathologist may incorrectly interpret the tissue given him.

The author does not attempt here to describe the different pictures presented by the various types of primary bone tumors, but rather to stress differentiation from inflammatory and traumatic conditions. In one case, which is presented in some detail, the roentgen findings were suggestive of osteomyelitis, and the correct diagnosis of Ewing's tumor was made only after biopsy. Traumatic lesions presenting diagnostic problems are illustrated by a report of a march fracture in a child previously operated upon for a myxochondrosarcoma and by an account of a patient in whom a posttraumatic overgrowth of the healing process gave a roentgen picture suggestive of sarcoma. In still another instance the problem was one of differentiating pathologic fracture due to multiple myeloma from fracture incident to senile osteoporosis.

The importance of an accurate diagnosis in determining treatment is illustrated by a case in which the distinction between a localized bone sarcoma and a leukemic process established the prognosis as hopeless and prevented useless amputation.

Thirteen roentgenograms.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Generalized Primary Lymphangiomas of Bone: Report of Case Associated with Congenital Lymphedema of Forearm. Raymond Harris and Andrew Prandoni. Ann. Int. Med. **33**: 1303–1313, November 1950.

A case of widespread multiple cavernous bone lymphangiomas associated with congenital lymphedema of

the left forearm is reported from the Walter Reed General Hospital. The patient was a 20-year-old soldier, who had first observed the presence of axillary masses at the age of seven. At the age of nine, lesions were observed roentgenographically in the ribs and humerus following a slight injury and were interpreted as hemangioma. At fifteen, biopsy of an axillary node showed cavernous lymphangioma, and a second axillary biopsy, five years later, confirmed this diagnosis.

On the patient's admission to the Walter Reed Hospital, generalized cystic lesions were found roentgenographically, involving most of the bones of the body. Skull films showed irregular cystic areas ranging in diameter from 0.5 to 1.5 cm., distributed predominantly in the vault and temporal bones. The bodies of the cervical vertebrae displayed similar cystic changes, as did the dorsal and lumbar spine. Both humeri, all the ribs, and the ulnar bones were involved, and there were areas suggestive of early minimal lesions in the femora.

Among the diagnostic possibilities considered were hyperparathyroidism, polyostotic fibrous dysplasia, and multiple hemangiomas. To obtain a definite pathologic diagnosis, a rib biopsy was performed on Oct. 8, 1946. The slides made from the specimen thus obtained were compared with previous microscopic sections taken in 1941 and 1946. The endothelial lining of the spaces in the rib, the coagulated contents, the delicate endothelial network, and the similarity of the cystic lesions in the rib and axillary tissues led to a diagnosis of lymphangioma of bone.

Treatment was minimal, and one and one-half years after initial examination the patient was asymptomatic. The prognosis is regarded as poor, however, despite the absence of malignant cells in the microscopic sections, since it seems likely that new lesions will develop.

Only one other case of primary lymphangioma of the bone was found in the literature (Bickel and Broders: J. Bone & Joint Surg. **29**: 517, 1947. Abst. in Radiology **50**: 271, 1948).

The origin of the bone lesions in the present case is not easily explained. It is considered that they are most likely congenital, the result of abnormal mesodermal rests developing into isolated, imperfect lymph vessels with a slight tendency toward abnormal growth. The tumors may have originated within the medullary portion of the bone and grown outward to produce expanding lesions in the affected bones. Another plausible etiologic concept is to consider this as a generalized metaplasia of the reticulo-endothelial system in which some unknown factor causes the cells to produce lymphangiomas.

Two roentgenograms; 1 photograph; 2 photomicrographs.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Osteoid Osteoma: A Case Report. Lawrence J. Cohen and David Van Brown. Surgery **28**: 751–754, October 1950.

A 21-year-old white male gave a history of pain in the right elbow for three years, especially severe at night. The pain was boring in type, appeared to be deeply located, and was localized to the medial aspect of the elbow. Roentgenograms of the elbow joint and shoulder had shown nothing abnormal. It was later discovered that some pain was produced by shaking hands and that pressure over the lower portion of the forearm duplicated the pain in the elbow.

Roentgenograms of the forearm revealed a sclerotic area of bone in the lower end of the radial shaft on its ulnar surface. The thickening resulted from periosteal new bone formation and its border was roughened. In the middle of the thickened cortical bone was a semicircular area of decreased density containing a central sclerotic focus. The lower border of the lesion extended to within 1 cm. of the distal end of the radius. The medullary cavity appeared to be unaffected.

A block of bone including the entire lesion was removed. During removal the block fragmented, exposing a central nidus of soft red tissue, which was shown microscopically to consist of irregular trabeculae of atypical calcified bone bordered in places by uneven zones of osteoid.

Although the pain in this case was characteristic of an osteoid osteoma, its radiation to a distant site was unusual.

Three roentgenograms; 1 photomicrograph.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Solitary Bone Cyst. Marcus J. Stewart and H. A. Hamel. South. M. J. **43**: 927–934, November 1950.

Localized osteitis fibrosa cystica is a circumscribed area of bone destruction isolated by a zone of fibrosing osteitis with insufficient reparative properties to produce healing. These solitary bone cysts occur primarily in the metaphyseal region of long bones. When adjacent to the epiphyseal plate, they are designated as being in the "active phase," when distant from the epiphysis as in the "latent phase." Roentgenographically the lesion is demonstrable as an area of central bone destruction with expansile smooth walls and irregular lines of trabeculae across the cavity. The cortex is uninterrupted; periosteal new bone production occurs only at the site of a pathologic fracture.

The authors discuss a series of cases seen at the Campbell Clinic (Memphis, Tenn.) in which various methods of treatment were used. They conclude that resection gives the most complete cure. When this is not practical, the most reliable method is thorough curettage of the cyst and its walls, followed by cauterization with 95 per cent alcohol, or phenol and alcohol, rinsing with saline and packing the cavity with autogenous or bone-bank bone.

Thirty-one roentgenograms; 2 photomicrographs; 5 tables.

JOHN M. KOHL, M.D.
Jefferson Medical College

Multiple Myeloma. II. Variability of Roentgen Appearance and Effect of Urethane Therapy on Skeletal Disease. R. Wayne Rundles and Robert J. Reeves. Am. J. Roentgenol. **64**: 799–809, November 1950.

Loge and Rundles in 1949 (Blood **4**: 201, 1949) studied 4 patients with multiple myeloma treated with urethane, during observation and follow-up periods ranging from seven to thirteen months. A selective beneficial effect exceeding that obtainable by other therapeutic agents was observed. Fever and pain subsided within a few weeks. Abnormal plasma cells decreased in number in the bone marrow and underwent morphologic changes indicative of retarded or arrested growth. In individuals with severe anemia, immature granulocytes and nucleated red cells disappeared from the circulating blood. The blood values subsequently improved or became normal. Serum protein abnormalities and Bence-

Jones proteinuria became less pronounced or disappeared. Serial roentgenograms of the skeleton showed no progression in the destructive lesions, and after four to six months there was the beginning of skeletal recalcification.

The present report summarizes at the end of two years a continuation of this study in a group of multiple myeloma patients now numbering 24. Eight of this group were inadequately treated. The remaining 16 received one or more courses of urethane: 90 to 270 gm. in two months to 1,850 gm. in eighteen months. In 9 cases the clinical results were "very satisfactory." In 3 others gratifying relief from skeletal pain was obtained, although one of this number died after six months of irregular treatment and one elderly patient continues to be incapacitated by recurrent pulmonary infections. One patient in whom myeloma was discovered before symptoms developed has remained well. Two patients apparently derived no benefit from the treatment and one was possibly made worse.

The authors have emphasized the range and variability of the roentgen appearances in multiple myeloma in the hope that early and accurate diagnosis may be promoted. In 3 of their series with generalized bone marrow involvement there was no roentgen evidence of skeletal abnormality. In 6 patients the initial symptoms and findings were those of localized bone tumors or destructive lesions, and in 2 there was pronounced diffuse demineralization easily confused with osteoporosis.

Serial roentgenograms of the affected bones showed little convincing evidence of repair during the first three months following urethane therapy, even in patients in whom the pain of advanced skeletal disease was relieved. By four to six months, recalcification and the reappearance of the trabecular pattern in bones subject to weight-bearing and other stresses were definite. It is believed that residual abnormalities of architecture will persist about fracture sites and large cystic areas. Skull lesions showed no progression after therapy but little tendency to heal. In view of these observations, it is apparent that response to treatment must be judged on other than roentgenologic grounds.

Ten illustrative case reports are included.

Twenty-three roentgenograms; 1 table.

HARRY HAUSER, M.D.
Cleveland City Hospital

Plasmacytoma of Lymph Node. Report of a Case with Multiple Myeloma. Morris A. Simon and S. Eidlow. New England J. Med. **243**: 335–338, Aug. 31, 1950.

A review of 127 cases of extramedullary plasmacytoma by Hellwig in 1943 (Arch. Path. **36**: 95, 1943) disclosed only 4 in which the plasmacytoma appeared to originate in the lymph nodes. A single additional example has been reported since that time (Jéquier-Doge *et al.*: Schweiz. med. Wchnschr. **77**: 186, 1947). The authors present another case, which was followed for three and a half years before fatal multiple myeloma developed.

The patient was first seen at the age of fifty-two, complaining of a painless swelling in the right inguinal region of four weeks duration. On physical examination, a hard, discrete, slightly tender mass, the size of a walnut, was found over the medial aspect of the right thigh, 3.8 cm. below the inguinal ligament. A biopsy of this node revealed an extramedullary plasmacytoma. No pathologic changes were demonstrable roentgenographically in the ribs, long bones, or skull. Three years later x-ray examination showed an area of destruction in the ninth rib on the right, compatible with a diagnosis of myeloma; there were no bony changes in the pelvis and skull. A month later x-ray studies revealed pathologic fractures of the ninth and tenth ribs in the posterior axillary line on the left, with many vacuolated and honeycombed areas of rarefaction within the upper third of the left humerus immediately below the surgical neck, as well as similar lesions in the inferior angle of the left scapula. These findings were interpreted as characteristic of multiple myeloma. The patient ran a progressively down-hill course. On repeated occasions, plasma cells in large numbers were demonstrated in the sternal bone marrow, and x-ray examinations showed new lesions in the ilium. He died forty-seven months after lymph-node biopsy.

It is possible that the disease in this case originated in the lymph node and later became disseminated, but it is equally possible that the bone marow was involved at the time of the biopsy, without x-ray evidence of bone destruction.

In either event, plasmacytoma in lymph nodes carries a grave prognostic significance and is usually followed, after varying periods, by clinically manifest myeloma.

One roentgenogram; 1 photomicrograph.

Melorheostosis Léri: Review of Literature and Report of a Case. Milton B. Spiegel and G. H. Koiransky. Am. J. Roentgenol. **64**: 789–794, November 1950.

Melorheostosis Léri is a purely local condition without generalized constitutional symptoms. There is usually local pain in the bone, varying from a vague "feeling" to a sharp penetrating ache. Characteristically the pain is of a vague boring nature with remission on rest. There may be abnormal curvature of the involved bone when the condition has started early in life, with or without shortening of the extremity. Pressure on the local nerves and blood vessels may cause paresthesia, neuralgia, venous congestion, and edema. The joints are usually not involved, but motion may be restricted by mechanical obstruction due to thickening of the contiguous articular surfaces or heterotopic ossification in the para-articular structures.

There is a characteristic selectivity for only one side of a bone (the femur or humerus), or a single bone where two lie parallel (either tibia or fibula; radius or ulna). Cases have been recorded in which all four limbs or both lower limbs, part of the pelvis, lumbar spine, and the skull were involved.

The diagnosis is made roentgenographically, since the microscopic findings are not pathognomonic. Notable features are dense opacity with the peculiar patchy linear distribution and localization to a single side of a bone or one of paired bones, mentioned above, and a coarse, irregular wavy outline.

Numerous hypotheses as to the etiology of melorheostosis have been offered. Putti believed the condition to be the result of local vascular obliteration produced by neurosympathetic vasomotor stimulation.

The course is that of insidious onset and slow progress, with periods of temporary or permanent arrest.

A case is added to the 49 previously appearing in the literature and regarded by the authors as acceptable.

Three roentgenograms.

SHOZO IBA, M.D.
Cleveland City Hospital

Infantile Cortical Hyperostosis. Harold W. Hermann, Ames W. Naslund, and Arthur E. Karlstrom. Minnesota Med. **33**: 1113–1114, November 1950.

A case of infantile cortical hyperostosis is reported, showing the characteristic features of this condition. Roentgen examination revealed massive hyperostosis in the bones of both forearms and moderate hyperostosis of the right mandible. There was no other area of involvement discovered from complete skeletal films. Lung fields were clear and heart size normal.

Seven months after the first evidence of the condition appeared, the hyperostotic areas had regressed without specific treatment.

Three roentgenograms.

A Case of Marie's Hypertrophic Pulmonary Osteoarthropathy Associated with a Biliary Cirrhosis. Gonzague de Meyer and Philibert Sarasin. Schweiz. med. Wchnschr. **80**: 1230–1233, Nov. 18, 1950. (In French)

Actually pulmonary disease accounts for only 68 per cent of the cases of so-called hypertrophic pulmonary osteoarthropathy. The primary disease may be bronchiectasis, chronic tuberculosis, empyema, pulmonary gangrene (abscess), or mediastinal tumor. Other conditions held responsible include congenital cardiac disease, intrathoracic lymphoma, certain malignant tumors, and cirrhosis of the liver.

The authors present a case in a 39-year-old woman, who, following a cholecystectomy, had a chronic retention icterus, with ensuing biopsy diagnosis of biliary cirrhosis.

A number of conditions are to be considered in the differential diagnosis. *Generalized hyperostoses with pachydermia* (generalized idiopathic familial osteophytosis of Friedrich-Erb-Arnold) occurs almost invariably in males, beginning at puberty and progressing slowly. Radiologically it is characterized by lamellated periosteal thickening and alternating zones of porosis and sclerosis in the spongiosa. Hippocratic fingers and spoon nails are also found. *Acromegaly* gives a definite clinical picture and is accompanied by pituitary tumor (eosinophilic adenoma). *Infantile cortical hyperostosis* involves the periosteum and not the spongiosa.

It has been shown that grave liver disease usually affects the skeleton. Usually there is an osteoporosis with fibro-osteoplasia. The following mechanisms are possible: hypocalcemia, increased phosphatase, acidosis, and vitamin and endocrine discrepancies. In the present case the alkaline phosphatase was 25 Bodansky units.

Five roentgenograms; 2 photographs.

CHARLES NICE, M.D.
University of Minnesota

Diagnosis of Minimal Atlanto-Axial Subluxation. Harris Jackson. Brit. J. Radiol. **23**: 672–674, November 1950.

Minimal atlanto-axial subluxation can be identified only by an increase in the distance between the posteroinferior margin of the anterior arch of the atlas and the odontoid process. This distance was measured in 50 normal adults and 20 normal children. In the adults, in flexion or extension, it was never greater than 2.5 mm. In children it was never greater than 4.5 mm.

In adults an increased distance indicates a subluxation. In children, as there is normally some forward motion, the diagnosis should be made only in the presence of confirmatory clinical evidence.

Three cases illustrating various phases of the problem are presented.

Four roentgenograms; 1 table.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Simulation of Herniated Cervical Disc by the Arnold-Chiari Deformity: Presentation of Two Cases in Adults. J. A. Colclough. Surgery **28**: 874–880, November 1950.

Two cases of the Arnold-Chiari deformity in adults, representing the sixteenth and seventeenth cases outside of infancy, are reported. It is the author's belief that these are the first reported cases in which this developmental abnormality of the neural axis has presented history, symptomatology, and physical, laboratory, and myelographic findings consistent with the diagnosis of herniation of a cervical intervertebral disk with radicular compression and pain. Briefly considered are surgical treatment, differential diagnosis, and postoperative follow-up. Liable to be confused with the Arnold-Chiari deformity when it simulates cervical disk herniation is disk herniation itself, tumor of the cervical cord, arthritis of the spine, and chronic hypertrophic spinal pachymeningitis.

Four drawings.

ALLIE WOOLFOLK, M.D.
Pittsburgh, Penna.

Dysphagia Caused by Exostoses of the Cervical Spine. Bertram Kertzner and Willis A. Madden. Gastroenterology **16**: 589–592, November 1950.

The authors report the case of a 61-year-old male who had complained of a "sticking" pain in the right side of the neck. X-ray studies revealed a large hypertrophic exostosis of the cervical spine which produced pressure on the esophagus and evidently was responsible for the patient's discomfort. A review of the literature is included.

Two roentgenograms.

J. G. LORMAN, M.D.
Indiana University

Diagnostic and Pathologic Evaluation of Congenital Block Vertebrae. P. Levrier and P. Temple. J. de radiol. et d'électrol. **31**: 661–664, 1950. (In French)

The authors describe the malformation known variously as vertebral synostosis, agenesis of the vertebral disk, and block vertebrae. The congenital union of several vertebrae is in most cases easy to recognize and is accompanied by kyphoscoliotic changes. The congenital union of two vertebrae has been confused with old osteoarthritis, although the conditions should be separable. As a rule, in block vertebrae, the upper cervical or lower lumbar area is involved (sacralization of fifth lumbar vertebra). The intervening disk is usually absent or almost absent, and bony trabeculae are seen between the two vertebrae. In osteoarthritis the disk has been attacked by disease, and there is usually spurring of the anterior margins where two vertebrae meet; in addition, the changes are likely to be encountered between the two extreme areas involved in block vertebrae. The foramen between two block vertebrae is of normal contour. Symptoms in patients with block vertebrae are due to static changes involving the disk spaces above and below the united vertebrae.

Six roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Significant Roentgen Findings in Routine Pre-Employment Examination of the Lumbosacral Spine. A Preliminary Report. M. Lowry Allen and Martin C. Lindem. Am. J. Surg. **80:** 762–765, Nov. 15, 1950.

Roentgen study of the lumbosacral spine as a routine part of the pre-employment physical examination is a relatively recent innovation in industry. This is a report on a series of 3,000 such examinations made over a two-year period at a large industrial plant. Anteroposterior and lateral views were taken on 7 × 17-inch films, with the individual recumbent and with a Potter-Bucky diaphragm. Although the limitations of such an incomplete study are appreciated—no oblique views being taken—the results are comparable to those obtained in mass chest x-ray surveys.

The various conditions encountered may be classified in five main groupings: (1) degenerative processes, as osteoarthritis and degeneration of the intervertebral disks; (2) post-traumatic lesions, as wedging or other types of fracture; (3) congenital and developmental anomalies; (4) post-surgical conditions, following spinal fusion or laminectomy; (5) miscellaneous conditions, not all of which represent spinal disorders. The largest number of cases fell into the first and third groups. Osteoarthritis accounted for 13.6 per cent of the entire series.

This study is interesting because it reveals the incidence of pathologic conditions and abnormalities of the lumbosacral spine in a large group of supposedly normal males who form a fairly accurate cross section of the nation's adult working population. It should give pause to those who are prone to account for many different symptoms on the basis of such conditions as were found in this asymptomatic group, and should help us to realize how frequently they are found among so-called normal adults.

Aside from furnishing scientific data, such studies are of aid to industry in compiling a permanent file on the employee's spine which may be useful in evaluating subsequent injuries from a medicolegal standpoint, in rejecting those who present a medicolegal hazard, and in job placement of men with potentially weak backs.

ROBERT P. BOUDREAU, M.D.
University of Pennsylvania

Technique and Results in Myelography and Disc Puncture. K. Lindblom. Acta radiol. **34:** 321–330, October–November 1950.

Following a brief description of the technic of myelography with a water-soluble contrast medium and a discussion of its limitations, the author outlines the method of disk puncture employed at the Caroline Hospital, Stockholm. A double needle is used. The outer one is inserted into the spinal canal, and the tiny inner needle into the disk. The puncture is performed under fluoroscopic control. When the needle is inserted far enough to reach the center of the disk, a mixture of 2.0 c.c. of 35 per cent contrast medium of the perabrodil type and 0.5 c.c. 5 per cent novocaine is injected. Moderate pressure is usually needed. In a normal lumbar disk it is possible to inject about 0.5 c.c. of the mixture; a ruptured disk can take much more because the dye leaks into the paravertebral or epidural tissue. Usually no more than 2 c.c. are injected. In most cases of ruptured disk the patient reacts to the increased tension so strongly that the injection must be interrupted earlier.

In most instances the patient will tell whether the injection reproduces his lumbago in its usual location, higher up, or lower down. Out of 38 patients in whom disk puncture was performed, 26 complained of marked sciatic pain in the affected leg during the injection of the offending disk.

In a few cases 0.5 per cent novocaine was first injected with the same results as with the mixture, showing that the lumbago and sciatica are produced by the tension and not by the contrast medium.

Immediately after the injection, films are taken of the injected disk in anteroposterior, oblique, and lateral projections.

Only 2 of the 52 punctured disks in the author's series showed normal spread of the contrast medium. The other 50 disks were more or less ruptured, with spread of the dye into the ruptures, into the whole space of the destroyed disk, and into the adjacent structures, mostly epidurally. The usual spread epidurally was along the affected roots or to form a deposit around the prolapse; less often the spread was more diffuse. In 4 patients a disk was found with definite rupture toward the outside of an intervertebral foramen and sciatic pains were reproduced by the injection.

The author believes that as a rule myelography and disk puncture are not needed for diagnosis and that these procedures should not be made unnecessarily but reserved for the purpose of preoperative localization.

Eight myelograms; 5 diskograms; 2 drawings; 3 photographs.

Lumbar Extradural Hematoma. Report of a Case Simulating Protruded Disk Syndrome. Hendrik J. Svien, Alfred W. Adson, and Henry W. Dodge, Jr. J. Neurosurg. **7:** 587–588, November 1950.

A case of lumbar extradural hematoma following trauma, in which the symptoms simulated those of a protruded intervertebral disk, is presented. Myelography demonstrated a complete block to the cephalad flow of the opaque oil opposite the upper border of the 3rd lumbar vertebra. The lesion producing the block appeared to be extradural. At surgery a hard fibrous mass situated to the left and slightly dorsal to the dura was encountered. This contained a black substance which appeared to be old blood. The pathological diagnosis was organized hematoma.

Only 10 cases of extradural spinal hemorrhage have been reported prior to this one.

One myelogram. HOWARD L. STEINBACH, M.D.
University of California

Inheritance of Spondylitis Rhizomelique (Ankylosing Spondylitis) in the K. Family. Herman H. Riecker, James V. Neel, and Avery Test. Ann. Int. Med. **33:** 1254–1273, November 1950.

Spondylitis rhizomelique, an ankylosing arthritis of the spine, associated with the names of von Bechterew, Marie, and Strümpell, is a disease of obscure etiology. It is generally regarded as a form of rheumatoid arthritis. The diagnosis rests on the clinical history of low back pain, usually with an onset in the twenties, the finding of a rigid, "poker" spine, an elevated erythrocyte sedimentation rate, and a characteristic roentgen picture of obliteration of the sacroiliac joints and calcification of the paravertebral ligaments.

In order to throw light on the genetic aspects of the disease, data were obtained on 87 related persons (including spouses) representing four generations, of whom 40 were seen by the authors.

Roentgen examinations of the cervical, dorsal, and lumbar spine were obtained on as many individuals as possible in generation II, and also, when possible, on others of the kindred who had symptoms referable to the spine or whose descent made such an examination of unusual interest. Erythrocyte sedimentation rates were obtained when possible.

Thirty-nine of the individuals seen were tested as to blood groups. Color vision and the ability to taste phenylthiocarbamide were also tested where the individuals were of suitable age, and a hair sample was obtained. These traits all have a well established genetic basis. The determinations were made in an attempt to establish the presence or absence of genetic linkages, as well as to provide a routine check on paternity.

In two generations, 5 proved cases of spondylitis rhizomelique occurred. This is a greater concentration in one kindred than can reasonably be attributed to chance. No person without spondylitis has produced a child with the disease.

Whether there is an "arthritic diathesis," must remain a moot point. Arthritis is so common a disease that, on the basis of chance alone, one can sometimes expect to observe in a single large sibship multiple occurrences representing several different types.

A direct genetic approach to this problem is, of course, impossible in man. The dangers involved in drawing sweeping conclusions from the study of a single pedigree require no comment. Further thorough investigation of large kindreds is desirable.

The condition appeared to be transmitted in the family here described as if it were due to a single autosomal dominant gene whose exact frequency of expression cannot be specified at the present time.

Five roentgenograms. STEPHEN N. TAGER, M.D.
Evansville, Ind.

Monostotic Fibrous Dysplasia of the Mastoid and the Temporal Bone. Charles E. Towson. Arch. Otolaryng. **52**: 709–724, November 1950.

Bone tumors of the mastoid are uncommon, and monostotic fibrous dysplasia of the mastoid and temporal bone is rare.

Monostotic fibrous dysplasia, ossifying fibroma, and non-osteogenic fibroma are variants of the same disease and cannot be distinguished from one another roentgenographically. The diagnosis of this disease is difficult because it resembles many other cyst-like lesions both benign and malignant and also because of the considerable confusion existing in the nomenclature and classification of cyst-like bone lesions. Roentgenograms are not diagnostic. The lesion is radiolucent and may be traversed by thin trabeculae. Thinning and expansion of the cortex occur.

The author reports a case of monostotic fibrous dysplasia in a 14-year-old Negro boy, whose only symptom was right-sided deafness. There was a history of a blow behind the ear about five years previously. A hard painless mass was present in the right mastoid process displacing the ear anteriorly and laterally. There was a bony growth in the right auditory canal and right-sided deafness. Roentgenograms showed a deformed, bulging mastoid process containing irregular radiolucent areas and bordered by a thinned cortex. The radiologist's diagnosis was a chondromatous or a giant-cell tumor. Exploratory biopsy showed a large cavity filled with cysts of varying size replacing the mastoid process. The pathologic diagnosis was cyst, but Dr. H. L. Jaffe, who reviewed the slides, called the lesion an ossifying fibroma.

During the next two years, the lesion grew slowly, and progressive expansion was noted on roentgenograms. A survey of the other bones was normal. Surgery was again performed and revealed a large central cavity filled with a clear fluid, lined by a thick gelatinous tissue and showing smaller cystic areas extending from the mastoid process into the petrous apex and into the zygomatic cells. The entire area including the middle ear was resected and at surgery the lesion was believed to be a unicameral cyst arising from embryonal remnants, probably ependymal. Within twelve hours after operation, the patient died from peripheral circulatory failure. Postmortem examination resulted in a diagnosis of monostotic dysplasia of the right mastoid process (a fibrous type of neoplasm with small areas of calcification).

Twenty-two illustrations, including 13 roentgenograms. CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Ski Injuries. Gordon M. Morrison and Edward J. Coughlin, Jr. Am. J. Surg. **80**: 630–635, Nov. 15, 1950.

This is a report of 254 ski injuries, including fractures and dislocations (124) and sprains (116), and a small group of miscellaneous injuries (14). The lower extremity is by far the most frequently injured. It was the site of 97 fractures and dislocations as compared with 21 of the upper extremity and 6 involving the trunk. Ninety per cent of all ski injuries occur after 3 P.M., as a result of the slower reaction in persons tired out toward the end of the day and the rapid change in skiing conditions as the sun sets.

The predominant injuries in this series, which comes from Massachusetts, were fracture of the lateral malleolus and spiral fractures of the tibia and fibula. Fractures of the metacarpals, particularly frequent in Switzerland, occurred in only 4 instances. There were 52 fractures of the lateral malleolus. The combination of the "fixed binding," incorporating the ski, binding, and the shoe in an integral unit, with inexperience in falling causes a torsional mechanism at the top of the ski boot with the resultant oblique fracture of the fibula just above the level of the boot. Spiral fractures of the tibia and fibula numbered 18. These torsion injuries usually occur when an experienced skier, going downhill fast, strikes a bare spot or hole in the snow.

The most frequent sprain in the series was a tear in the internal lateral ligament of the knee, there being 47 such injuries. These were usually associated with a torsional strain, the ski being fixed and the body rotated as the knee was adducted. A combination of tearing of the internal ligament of the knee and the external ligament of the ankle was frequent.

To reduce injuries to the lower extremities the authors advise that beginners receive adequate skiing instructions and that skiers use the so-called "safety binding" rather than the "fixed binding" ski boot.

Seven roentgenograms.

RICHARD V. WILSON, M.D.
University of Pennsylvania

Primary Carcinoma of the Nail. Lyle W. Russell. J. A. M. A. **144**: 19–21, Sept. 2, 1950.

A case of primary carcinoma of the nail in a 37-year-old man is reported. This patient had noticed the

gradual development of a "sore" on the lateral edge of the nail of the right index finger. After two months the end of the finger became swollen but not painful. The family physician, on a presumptive diagnosis of paronychia, made an incision along the lateral border of the finger. Instead of obtaining purulent material, he encountered a white cheesy substance. When the patient was seen by the author a few days later, there was a large bulbous swelling of the distal end of the right index finger, which was only moderately tender to pressure. In the sulcus of the nail, on the radial side of the finger, was a small crater, about 5 mm. in diameter, filled with a yellowish crust. Further questioning of the patient brought out the fact that nine months prior to the appearance of the "sore" the finger had been pinched by an air hammer. Roentgenograms revealed swelling of the soft tissue involving the terminal end of the right index finger and considerable bone loss along the lateral surface of the terminal phalanx, involving all except the extreme tuft and the articular margin. In order to save as much of the finger as possible, amputation was performed through the distal interphalangeal joint. At the time of the report, eight and one-half months later, there was no evidence of local recurrence in the stump or of metastasis to the regional lymph nodes.

The appearance of the lesion in the sulcus of the nail is the most distinguishing characteristic of carcinoma of the nail. However, its significance may be minimized when decided swelling of the finger and erosion of the bone are present. Hence, confusion with the following conditions may arise: chronic paronychia, tuberculous dactylitis, syphilitic dactylitis, glomus tumor, and enchondroma.

Four illustrations, including 2 roentgenograms.

Bone Repair in Rats with Multiple Fractures. Marshall R. Urist and Franklin C. McLean. Am. J. Surg. **80:** 685–695, Nov. 15, 1950.

The authors present a discussion of experimentally produced multiple fractures in rats which were divided into six groups according to age, site of fracture, time interval between fracture production, and degree of intentional interference with healing of the fractures.

A roentgenographic survey of the skeleton was made at ten-day intervals and levels of serum calcium and phosphorus were determined. The following conclusions are reached:

1. Experimental multiple fractures produced concurrently, or in serial operations at short intervals, healed in the same period of time as single fractures in both young and old rats.

2. A normal diet provided enough calcium and phosphorus to sustain calcification of the callus and to permit solid union of the bones of either immature or adult animals with 22 simultaneous fractures or 44 serial fractures. Bone salt was not mobilized from the spine or uninjured parts of the skeleton. The serum phosphorus, however, was slightly elevated ten days following a fracture.

3. Delayed union or non-union was observed only in association with regional factors. In double fractures of the shaft of the long bones, there was frequently delay in union. A consistent reaction, possibly based on the direction of the damaged nutrient vessels, was observed in the tibia and femur. In the tibia the proximal fracture line united in the normal period of time and the distal fracture always united later. In the femur the distal fracture line united on the normal schedule and there was frequently delayed or non-union in the proximal fracture line. Non-union was often noted in the upper femur when the bone ends were displaced into separate muscle compartments. Non-union was also produced experimentally by repeated fractures of the callus, probably due to interference with its organization.

4. The apparent inexhaustible capacity of the body to heal fractures (except when the aforementioned local conditions are present which lead to non-union) may be related to systemic breakdown of muscle protein which liberates the building materials needed for construction of new bone.

Eighteen roentgenograms.

JOHN F. GIBBONS, M.D.
University of Pennsylvania

GYNECOLOGY AND OBSTETRICS

Hysterography and Hysterosalpingography. An Evaluation of 2,500 Cases. M. A. Goldberger, Richard Marshak, and Arthur Davids. New York State J. Med. **50:** 2697–2704, Nov. 15, 1950.

The authors reviewed 2,500 cases in which hysterography or hysterosalpingography was done, in an effort to evaluate these procedures and determine their safety.

The indications for contrast visualization of the uterus and tubes are menometrorrhagia, dysmenorrhea, sterility, fibroid uterus, postmenopausal bleeding, and congenital anomalies. Contraindications are acute and subacute pelvic inflammatory disease, intra-uterine pregnancy, chronic cervicitis with purulent discharge, vaginitis, active uterine bleeding, and serious constitutional disease.

The authors use the standard fractionated method of study. Water-soluble media have been found very satisfactory despite the fact that they do not permit a 24-hour film, and therefore patency is sometimes not established. The more viscous materials are excellent for hysterography but, when employed to visualize the tubes, they may in rare instances result in fat granulomas and emboli. When lipiodol is used for demonstration of the tubes, the injection is discontinued when an obstruction to the flow of dye at 200 mm. of pressure is encountered. With the water-soluble media, the authors apply pressures up to 250 mm. of mercury, since the danger of embolism is less. In an occasional case in which the tubes are so spastic as to withstand this pressure lipiodol is helpful, as the 24-hour film will differentiate between spasm and organic closure.

Hysterography is valuable in those cases where the history and physical findings do not reveal the presence of intra-uterine disease, but where its presence is suspected. The following conditions have been demonstrated by the authors: endocervical and endometrial polyps, intramural and submucous uterine fibroids, hyperplastic endometrium, endocervicitis, retained products of conception, pregnancy, ovarian tumors, carcinoma, tuberculous endometritis, congenital anomalies, and anteflexion and retroflexion of the uterus. With hysterosalpingography it has been possible to demonstrate patency of the tubes, spasm, hydrosalpinx with and without closure of the tubes, site of tubal occlusion, displacement of the tubes, tuberculous salpingitis, and ectopic gestation.

Complications are not in general serious. They include pain, peritoneal irritation, endometritis, emboli,

allergic phenomena, and, more rarely, hemorrhage, perforation of the uterus, acute exacerbation of chronic pelvic inflammatory disease, shock, entrance of dye into the uterine vascular structure, and its introduction into a pregnant uterus. The serious complications are so rare that they should not be considered a contraindication to the procedure.

Thirteen roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Hysterography and the Study of Carcinoma of the Cervical Canal of the Uterus. Giuseppe Maurizio Reviglio. Radiol. clin. **19**: 364–371, November 1950. (In Italian)

The author describes the results and findings in a series of cases of carcinoma of the cervical canal. The value of hysterography with 40 per cent lipiodol is particularly emphasized. The more fluid type of contrast medium does not remain in the uterine cavity long enough for a proper study of small defects. The author demonstrates that in many cases in which the cancer seems to be confined to the region of the cervix, as in Stages I and II, further studies by hysterography reveal extension into the isthmus and sometimes involvement of the corpus. He describes the important radiological findings, such as minimal erosion, deviation from the normal triangular configuration of the uterine cavity, and loss of normal elasticity in the body of the uterus. Once a suspicious deformity is discovered by this method, a biopsy should follow.

In Stage I and II carcinoma of the cervix the information furnished by hysterography is valuable in appraising the macroscopic extension of the neoplastic process. The procedure is of equal importance for the demonstration of a neoplastic lesion in cases in which there is a paucity of significant signs or symptoms.

The author states that the danger of hysterography is rather theoretical than real. He emphasizes the use of this procedure not only in the study of the extent of disease but also in relation to subsequent therapy.

MICHAEL INDOVINA, M.D.
Chicago, Ill.

A New Method of Quantitative Estimation of Cephalopelvic Disproportion. Howard C. Moloy and Charles M. Steer. Am. J. Obst. & Gynec. **60**: 1135–1142, November 1950.

The authors describe a new method of estimating cephalopelvic disproportion. The films taken are (1) anteroposterior stereoroentgenograms; (2) a standing lateral film; (3) a view of the subpubic arch. The films are taken late in the last trimester, usually in early labor. On the lateral film a genital fold marker is used rather than a gluteal fold marker. The marker is held in place by straps over the patient's shoulders and greatly facilitates positioning.

For the purpose of estimating degrees of disproportion there has been constructed a set of cardboard circles of known diameters, graduated from 8.0 to 12.5 cm. in 0.25 cm. intervals. Various circles are superimposed over the stereoscopic image of the inlet until one just fits. When of the proper size, the circle should touch the pelvic inlet at two or three places, usually at the junction of the first and second sacral segments posteriorly, and the two sides of the forepelvis anteriorly. It must not overlap at any point. The circles are then used to judge the size of the fetal head. The diameter of the circle for the head is subtracted from the diameter of the circle for the inlet. The difference is the significant figure of the method.

From repeated measurements of the pelvis and fetal head it has been determined that there results an experimental or possible error of ±3.0 mm. for the difference.

A series of cases of inlet disproportion and a series of cases of midpelvic disproportion are reviewed. It is concluded that when the x-ray findings indicate a very high degree of disproportion, they should be given considerable weight. These cases are best treated by cesarean section. When borderline disproportion is present, the clinical factors, especially the quality of labor, will carry most weight. In general, a trial of labor is indicated in most of these cases. When no disproportion is present, the clinical factors are all-important.

Four figures; 2 tables.

JOHN M. KOHL, M.D.
Jefferson Medical College

THE BLOOD VESSELS

(See also under The Chest)

Observation on Chronic Obstruction of the Abdominal Aorta. Leriche's Syndrome. Bernardo Milanes, Eliseo Perez Stables, and Jose S. Lastra. Surgery **28**: 684–698, October 1950.

Primary obstruction of the aorta is rare because seldom is an isolated arteriosclerotic or inflammatory lesion capable of producing thrombosis of this vessel. Usually, the bilateral obliteration of the iliac arteries secondary to atheromatous changes is the factor responsible for the aortic thrombosis. Obliteration of one of the iliac arteries alone gives way to a unilateral ischemic syndrome, but the authors have not observed thrombosis of the aorta in such a case. In 4 cases in which anatomic studies were made, thrombosis of the aorta was found to be accompanied by obliterating arteriosclerotic lesions of both iliac arteries. The aorta thus obstructed acts as a reflex center capable of producing distant spasm that would explain the clinical symptoms which are observed in these cases. This is one of the reasons why Leriche has advocated aortoiliac resection as the proper method of treatment.

The patients first complain of coldness and easy fatigability along with weakness of the lower limbs on walking. In advanced cases the symptoms depend upon the condition of the collateral circulation; bilateral intermittent claudication will appear together with loss of sustained erection. Aortic obstruction is at first compensated for a long period of time, usually five to ten years, before trophic symptoms appear. After distant extension of the thrombosis, peripheral gangrene develops. In some cases the progression of the thrombosis is proximal and the occlusion of the mesenteric and renal arteries may lead to death.

Physical findings are: (1) absence of pulsation and oscillation in both inferior extremities; (2) absence or greatly diminished pulsation in both iliac arteries and infra-umbilical segment; (3) muscular atrophy with loss of the hair of the lower limbs, which at the same time may present a more or less marked discoloration.

Although the clinical signs and symptoms are nearly always sufficient to make a diagnosis of aortic obstruction, its extension and site will be unknown if an x-ray examination of the abdominal aorta with an opaque substance is omitted. Aortography gives interesting in-

formation concerning the collateral circulation which is of great importance in establishing the indications and contraindications for surgical treatment.

The ideal form of treatment would be to resect the thrombosed area and bridge the gap with a vessel graft but this is not possible. In selected cases the collateral circulation is improved by bilateral resection of the lumbar sympathetic chains and a resection is made of the terminal portion of the aorta and both iliac arteries. Resection is contraindicated when the thrombosis ascends centrally, reaching the vicinity of the renal arteries. Resection of the bifurcation of the aorta is usually preceded by a one-sided sympathectomy. One week or more later the resection is performed along with sympathectomy of the other side.

Thirteen case reports are included.

Thirteen illustrations, including 10 roentgenograms; 1 table.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Translumbar Aortic Puncture and Retrograde Catheterization of the Aorta in Aortography and Renal Arteriography. William E. Goodwin, Peter L. Scardino, and W. W. Scott. Ann. Surg. **132**: 944–958, November 1950.

The authors compare needle puncture of the aorta for the injection of an opaque medium with the catheter method of aortography and renal arteriography. Both procedures seem safe, and each gives satisfactory visualization of the renal and other vessels under optimum conditions. The chief advantage of the catheter method lies in the possibility of placing the dye injection at any level. The needle method is, however, much simpler and quicker after facility is gained in the technic of aortic tap, and the complications are fewer. This, the authors believe, more than outweighs the advantage of the catheter method. At present they consider that the needle method of aortography is the method of choice. If that fails or is unsatisfactory for any reason, the catheter should be employed.

The technic of both procedures is described. The authors' catheter method is unique in that it uses a lesser branch of the profunda femoris artery which can be ligated with impunity in so far as it is a relatively small artery, yet large enough and close enough to the femoral artery to allow the passage of the catheter. An excretory urogram is always obtained prior to the catheterization.

Femoral artery catheterization according to the technic described was done 15 times in 14 patients with generally satisfactory results. Complications were of a minor character, possibly attributable to inexperience with the method.

Eleven roentgenograms; 10 drawings.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Retrograde Aortography with a Special Catheter, Including Demonstration of the Coronary Arteries. Felix Pearl, Norman Gray, and Bruce Friedman. Ann. Surg. **132**: 959–964, November 1950.

The authors point out the disadvantages of various technics suggested for the roentgen demonstration of the great vessels and describe their own method of aortography. This involves the use of a thin-walled radiopaque catheter which may be inserted into a peripheral artery and may be guided to any part of the aorta from the aortic sinus to the bifurcation of the abdominal aorta. The outside diameter of the catheter is 2.5 mm., small enough so that the artery of insertion may be readily restored by suture, while the lumen (0.59 mm.) is large enough to transmit 5 c.c. of fluid per second with simple manual pressure. The segments of origin of the radial and profunda femoris arteries appear to be good sites for the insertion of the catheter.

Experience with the procedure in dogs and in the one human subject in which it had been employed is recorded. It allows one to take selective arteriograms of any portion of the aorta with use of only a few cubic centimeters of radiopaque liquid. The coronary arteries may be regularly demonstrated by this method. The arteriograms show excellent contrast, since the vessels visualized are not obscured by an excess of radiopaque material.

Five roentgenograms.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Portal Venography. George E. Moore and Richard B. Bridenbaugh. Surgery **28**: 827–831, November 1950.

A method for the roentgen contrast visualization of the portal vein and the intrahepatic radicles of the portal vein is presented. The very meager literature on the subject is reviewed. This study is primarily concerned with the technical factors involved. The examinations reported were incidental procedures done at time of laparotomy in connection with various surgical procedures.

The right gastro-epiploic vein was most commonly used, although any of the portal vein tributaries is considered satisfactory. With a Polythene catheter and 20 c.c. of 35 per cent diodrast, the important factors influencing good visualization were found to be: (1) direct injection of the contrast medium into the portal vein; (2) rapid injection of the contrast medium; (3) complete arrest of respiration during x-ray exposure; (4) proper timing of the exposure in relationship to the injection.

The practical applications of this procedure remain to be determined.

Four roentgenograms.

ALLIE WOOLFOLK, M.D.
Pittsburgh, Penna.

Venous Velocity in the Leg Measured with Radioactive Sodium. J. Elliot Levi and Edward F. Lewison. Bull. Johns Hopkins Hosp. **86**: 370–382, June 1950.

Although most medical opinion concedes the importance of venous stasis as a factor of primary concern in contributing to the development of thrombosis and embolism, the fundamental facts of the mechanical aspects of venous stagnation have received only limited attention. The present study reports a precise, direct, and totally objective method for the determination of segmental linear venous velocity with the use of radiosodium 24.

In a series of 40 normal subjects this velocity as measured from ankle to groin was found to be 3.8 ± 0.37 cm. per second. Eighty-eight per cent of the venous velocity determinations were between 1.2 and 5.0 cm. per second with extremes of 1.3 and 13.0 cm. Age and sex were not observed to influence the rate of flow.

In 45 per cent of the normal subjects in the series, radiosodium 24 was found to persist in the region of the mid-calf following injection. This puddling phenom-

enon was not influenced by posture and in one case was observed twenty-four hours after introduction of the isotope.

Four figures.

FOREIGN BODIES

Roentgenological Diagnosis of Sponge in the Abdomen. M. Slater. Am. J. Roentgenol. **64:** 781–784, November 1950.

A case is presented in which a preoperative diagnosis of a surgical sponge in the abdominal cavity was made and verified. The diagnosis was based on persistence of a small, localized collection of bubbles of air trapped in the mesh of the sponge. The bubbles of air were in a circumscribed area, were smaller and more uniform in size than intestinal gas, and did not change in appearance or location when the patient's position was shifted on separate days. The author cites a second case in which a correct diagnosis was made later at another hospital, based on the same criteria.

Five roentgenograms.

DONALD F. MAURITSON, M.D.
Cleveland City Hospital

CONTRAST MEDIA; TECHNIC

(See also under The Head and Neck)

An Experimental Study of the Cardiovascular Effects of Diodrast. Alvin J. Gordon, Sigmund A. Brahms, Samuel Megibow, and Marcy L. Sussman. Am. J. Roentgenol. **64:** 819–830, November 1950.

This experimental study of dogs subjected to intravenous injection of diodrast was undertaken to determine reactions to this material with a view to their ultimate prevention or alleviation. Observations were limited to the cardiovascular system.

Fifteen male dogs weighing from 6 to 13 kg. were given intravenous sodium nembutal anesthesia and heparin to prevent blood clotting. Simultaneous venous and arterial pressures were recorded and leads one, two, and three of the electrocardiogram were obtained. Diodrast was given in 35 and 70 per cent concentrations, in 10 and 20 c.c. amounts, either as rapidly as possible (one or two seconds) or over a three-minute period.

The typical diodrast reaction following rapid injection of 20 c.c. of 70 per cent solution began with a slight rise of both the systolic and diastolic pressure within one to two seconds after the beginning of the injection. In two to five seconds a slight increase was noted in the height of the ventricular complexes of the electrocardiogram. At ten seconds the heart rate slowed, and at fifteen the mean arterial pressure began to drop. Venous pressure changes were inversely proportional to the mean arterial pressure. Arterial pressures returned to the initial level in approximately four minutes, the pulse rate usually within three minutes, the electrocardiogram within two to three minutes. Between ten and thirty seconds stimulation of rate and depth of respiration often occurred, although occasionally respiration slowed. Profuse salivation sometimes was noted several minutes after injection.

A dose of 10 c.c. of 70 per cent or 20 c.c. of 35 per cent diodrast, when given rapidly, produced the typical reaction, but with a slow rate of injection, the effect was reduced in time of development and intensity.

The reaction following a repeated dose, after subsidence of the reaction from the original injection, was unchanged.

Diodrast is considered a potent vasodilating agent probably acting directly on smooth muscle of the vessel walls. Atropine, vagotomy, pitressin, phenargen, and tetraethylammonium failed to prevent the cardiovascular reaction to diodrast in dogs. The sympathomimetic drugs did not affect the diodrast reaction but obscured it when given in large doses, depending on the rapidity of onset and duration of their action compared to that of diodrast.

The bradycardia in the diodrast reaction is presumably a result of direct reaction on the myocardium. An adequate explanation for the rise of venous pressure is not available.

Two diagrams; 1 table.

MILTON SEGAL, M.D.
Cleveland City Hospital

Personal Experience with Ethyl Di-iodostearate in Arteriography. S. Masy. Acta radiol. **34:** 350–356, October–November 1950. (In French)

Iodine compounds of the diodrast, diodone, or umbradil type have certain disadvantages in vasography, including vascular spasm, pain, and occasional tissue necrosis if the substance reaches the extravascular tissues, while thorotrast presents the dangers of radioactivity. Vasoselectan, a colloidal suspension of ethyl tri-iodostearate, was made by Schering before the war. Since the war it has not been available. It gave promise of overcoming the disadvantages of the other contrast substances.

A Belgian chemical firm has made a similar product: a suspension of ethyl di-iodostearate in glucose water. It causes no pain, is well tolerated and rapidly eliminated by the kidneys, and is very opaque. Also, in five minutes after injection the liver and spleen are visualized. After one hour the opacification of the liver diminishes and in twenty-four hours disappears completely. Doses up to 2 c.c. per kilo are well tolerated in experimental animals. In the rabbit, an enormous dose, 5.0 c.c. per kilo, produced death with generalized convulsions and opisthotónus.

Doses of 20 to 60 c.c. have been used in arteriography. In one patient only, a self-limiting reaction, probably due to iodism, was encountered.

Cerebral and peripheral arteriograms are reproduced. Commercially the drug is known as angiopac.

Four roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

A Fatal Case of Delayed Hypersensitive (Anaphylactic) Reaction to a Test Dose of Vasiodone. A. C. A. Coombes and E. H. Roche. Brit. Heart J. **12:** 360–362, October 1950.

Preparatory to obtaining an angiocardiogram on a 10-year-old girl she was given 0.1 ml. of vasiodone intradermally and 1 ml. intravenously to test for sensitivity. An hour and a half earlier she had received 100 mg. of anthisan (an antihistaminic) by mistake. This was supposed to have been given after the sensitivity tests but before the main injection. Twenty minutes following administration of the test dose of vasiodone there was a sudden collapse with cyanosis, followed by convulsions. Treatment was begun immediately, but the patient went into coma and died three days later. The authors ascribe the delay in onset of the reaction to the antihistaminic given before

the tests. Family history of allergy was at first denied, but subsequent questioning brought out various allergic manifestations.

At autopsy the usual petechial hemorrhages were found in the brain, but otherwise the organs were normal, with the exception of the heart, which showed several defects in the interatrial septum.

To insure safer administration of vasiodone and similar radiopaque substances intravascularly, the authors advocate (1) very careful questioning regarding a family history of allergy, (2) a smaller initial intravenous test dose (0.1 ml.) to be followed by a second dose of 1.5 ml. if there is no reaction; (3) correct use of antihistamines, *i.e.*, following conclusion of the tests.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgenological Diagnosis: Generalized Subserous Emphysema Through a Single Puncture. M. Ruiz Rivas. Am. J. Roentgenol. **64**: 723–734, November 1950.

Utilization of the radiolucent effect of air introduced into tissues of homogeneous density as a diagnostic procedure is not new. Production of a generalized subserous emphysema following a single needle puncture is a unique recent application of this principle.

Though subserous cellular tissue is to a certain extent compartmentalized, the boundaries of each compartment are often ill-defined; points of communication are frequent, and the dividing membranes are weak or incomplete. Because of this anatomical continuity of the deep cellular tissues, emphysema instituted at certain levels can be made to spread through the body. The tissue which lends itself best to this procedure is undoubtedly that of the pelvic region, and within the pelvis the author selects the pararectal tissue toward its posterior aspect, "because of its accessibility, its ample communication with the retroperitoneal tissue, and finally because of the tendency of all gaseous infiltration to climb upward."

With a single puncture of the pelvis, the cellular tissues of the abdomen and pelvis are easily made emphysematous. Although some gas will be seen routinely in the supradiaphragmatic regions during this procedure, better visualization of these tissues may be obtained by other methods.

For the needle puncture, the author prefers to have the patient in the genupectoral position. The needle is introduced at the level of the sacrococcygeal joint 1 or 2 cm. beyond the inferior border of the sacrum, and is directed obliquely upward, inward, and forward, so that the point comes to rest just anterior to the sacrum in the mid-line presacral or retrorectal cellular tissue. Following attempted aspiration to exclude an intravascular position, a few cubic centimeters of air are introduced. If the gas enters easily, position in loose cellular tissue is assured, further manipulation is not required, and the oxygen injection may proceed.

Following production of pelvic emphysema, the gas ascends into the abdominal retroperitoneal space to produce a "retropneumoperitoneum," including the retroperitoneal as well as the intrarenal fascial space (perirenal insufflation area). This procedure is more efficient than "perirenal insufflation" because, with a single puncture, bilateral kidney visualization obtains, irrespective of kidney position.

If the patient breathes deeply and pressure is used, the adrenals are visualized, unless they are firmly adherent to the kidneys. The liver and spleen are well delineated. The ovaries, fallopian tubes, leaves of the diaphragm, and thyroid have been demonstrated by this technic.

Embolism is not a serious consideration, for the skin is the most vascular tissue crossed by the needle. No parenchymal tissue can be damaged by the method.

Twelve roentgenograms; 14 diagrammatic drawings.

EDWARD E. TENNANT, M.D.
Cleveland City Hospital

Advantages of Compression of the Abdomen in Roentgenography of the Lumbo-Sacro-Coccygeal Vertebrae. Rosario Corseri. Ann. radiol. diag. **22**: 401–411, 1950. (In Italian)

This article is a timely reminder of an ancient technic which unfortunately is commonly disregarded today. The compression of the abdomen by means of an inflated rubber balloon results in less secondary fog and decreased thickness of the part. The illustrations in this paper demonstrate the improved results which can be achieved by using the same attention to detail which allowed the older radiologists to obtain striking radiographs before the advent of the Potter-Bucky grids and of rotating anode tubes.

Eleven roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

RADIOTHERAPY

Treatment of Malignant Tumours of the Nasopharynx. Simon Kramer. Proc. Roy. Soc. Med. **43**: 867–874, November 1950.

This presentation is based on a series of 54 cases of nasopharyngeal tumors treated at the Middlesex Hospital, London, in a period of fourteen years. The incidence, age and sex distribution, and presenting symptoms roughly paralleled the experience of others. An interesting note regarding the type of initial symptoms relates to elapsed time before the first treatment, indicating that, where oto-rhinological symptoms developed, the diagnosis was made earlier than in cases in which cervical node enlargement or nerve lesions were the first manifestation.

Lateral soft-tissue films of the nasopharynx, tomograms, stereoscopic films of the skull, and submento-vertex views are all of aid in diagnosis.

In a brief discussion of pathology, the author points out that it would clarify matters if tumors and histology were correlated with normal structures. His classification is made on that basis. Thus, three general types of carcinoma are recognized: squamous-cell carcinoma arising from squamous epithelium, transitional-cell carcinoma arising from respiratory epithelium, and lympho-epithelioma arising from lympho-epithelial structures. Within the three groups there exist variations in the degree of differentiation. Since at times the least differentiated types may give no indi-

cation of their parent epithelium, a further group is included: the undifferentiated carcinoma. The degree of keratinization of the squamous-cell carcinoma may be used as a basis of further subdivision, but the author has included growths with little or no keratinization in the undifferentiated group.

In this series carcinoma predominated and, curiously, no cases of lymphosarcoma were seen. There were several connective-tissue tumors, of which 3 were reticulum-cell sarcoma, 1 plasma-cell sarcoma, and 1 spindle-cell sarcoma. Generally, the undifferentiated carcinoma and lympho-epithelioma bore great resemblance to each other in their growth behavior, early and extensive lymph node involvement, and response to irradiation. The transitional-cell carcinoma, which usually responded well to therapy, had a strong tendency to local recurrence.

Deep x-ray therapy was given by two general methods: The radiosensitive group, in which cervical metastases were often bilateral, received regional treatment, a large area from the base of the skull to the clavicle being irradiated through two large lateral fields. The tumor dose was 3,000 to 3,500 r in four to five weeks. In the second group, in which the more highly differentiated growths predominated, when no nodes were palpable in the cervical region, intensive treatment was given through small beam-directed fields planned to irradiate the nasopharynx and local extension of the tumor; the tumor dose was 5,500 to 6,000 r in six to seven weeks. Where cervical nodes were palpable in this group, these were irradiated through large fields, with a tumor dose of 2,000 r in two to three weeks. The physical factors employed were 200 to 250 kv., 10 ma., Thoraeus filter, or filtration of 1 mm. copper plus 1 mm. aluminum, h.v.l. 2.4 and 1.4 mm. of copper, respectively.

An over-all five-year cure rate of 25.8 per cent was obtained. The lympho-epitheliomas and the undifferentiated carcinomas showed the best five-year results: 40 and 36 per cent respectively. The differentiated squamous-cell carcinomas and the transitional-cell carcinomas showed the worst results, particularly the latter. The survival rate was slightly higher in those cases where no cervical nodes were palpable. In cases in which invasion of the base of the skull occurred, the prognosis was poor. In the majority of fatal cases death or recurrence took place within two years of the first treatment, so that any patient surviving for three years after treatment without signs of disease is believed to have a good chance of permanent cure.

Seven roentgenograms; 4 photomicrographs; 1 photograph; 2 diagrams; 2 tables.

HERBERT D. KERMAN, M.D.
Oak Ridge, Tenn.

Roentgen Therapy Supplementing Surgery in the Treatment of Gliomas. G. M. Tice and N. W. Irving. J. Neurosurg. **7:** 509–520, November 1950.

Fifty-two patients with proved brain tumors were given x-ray therapy during the sixteen years prior to Jan. 1, 1949. Of this number 15 were living at the time of this report and 37 were dead. The astroblastoma group, numbering 13 cases, showed an average survival rate of 46.4 months, with 30 per cent alive for five years. The cellular meningiomas and hemangioblastomas, which are classified together because they are radiosensitive and "non-metastasizing," constitute a group of 5 cases, with a single five-year survival. The glioblastoma, spongioblastoma, and oligodendroglioma, which are classed together as relatively insensitive brain tumors, showed no five-year cures. The average survival in this group was sixteen months. Sixteen cases of medulloblastoma were treated, with an average survival of 21.3 months. No patients with medulloblastoma survived five years.

Most of the patients in this series were treated at 200 kv.p., h.v.l. 0.9 mm. copper. For the last two years 250 kv.p., with h.v.l. 1.7 mm. of copper, was used. According to the technic now employed, the average brain tumor in the adult receives a dose of 5,000 r (4,000 r in a child) in 25 to 30 treatments, through four portals. Treatments are given daily except Sunday.

Two tables.

HOWARD L. STEINBACH, M.D.
University of California

The Case for Branchiogenic Cancer (Malignant Branchioma). Hayes Martin, H. Mason Morfit, and Harry Ehrlich. Ann. Surg. **132:** 867–887, November 1950.

Branchiogenic cancer is a purely theoretical entity. The only absolute proof of its existence would be the histologic diagnosis of cancer arising in the wall of a branchiogenic cyst, and to the authors' knowledge no well documented case of this kind has ever been recorded. However, certain rare cervical tumors are encountered for which there appears to be no other reasonable explanation.

The authors carefully review the literature, furnishing an excellent bibliography, and present the Memorial Hospital (New York) criteria for the tentative diagnosis of branchiogenic cancer, as follows: (1) The cervical tumor must have occurred somewhere along a line extending from a point just anterior to the tragus of the ear, downward along the anterior border of the sternomastoid muscle, to the clavicle. (2) The histologic appearance of the growth must be consistent with an origin from tissue known to be present in branchial vestigia. (3) The patient must have survived and have been followed by periodic examinations for at least five years without the development of any other lesion which could possibly have been the primary tumor.

The possibility of misinterpreting as branchiogenic cancer a metastasis from a silent nasopharyngeal tumor is illustrated by a case report. Actually cervical metastases appear as the earliest symptom in over 50 per cent of carcinomas of the nasopharynx.

A series of 15 cases of cervical cancer without any other demonstrable primary tumor, with five-year survival following treatment, is reviewed. In the presence of a cervical mass of unknown origin proved to be cancer it is held to be more prudent to defer surgery and apply radiation therapy to the mass while continuing the search for a primary lesion. In most cases a combination of fractionated roentgen radiation and gold radon seeds will permanently sterilize the local tumor while preserving intact what remains of the protective screen of lymphatics. Under such a plan, should a primary lesion appear later (which it usually does), treatment can be instituted to the primary growth and to any metastasis with the assurance that previous radiation therapy has not seriously affected the clinical setting.

The authors feel that the diagnosis of branchiogenic cancer is too frequently and loosely made. Though the theory of its occurrence has been passively accepted for more than seventy years and has become ingrained in

medical thought, it is based solely on presumptive evidence.

Four photographs; 4 photomicrographs.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Hormone Therapy in Relation to Radiotherapy in the Treatment of Advanced Carcinoma of the Breast. Basil A. Stoll. Proc. Roy. Soc. Med. **43**: 875–882, November 1950.

The author reports the results obtained in advanced cancer of the breast receiving hormone therapy at the London Hospital between 1945 and 1949.

Estrogen Administration: Patients in the older age group were chosen for estrogen therapy because of the suggestion that disappearance of the estrogenic hormone after the menopause exerts an adverse effect on breast cancer and this is probably associated with oversecretion of pituitary gonadotropin. Estrogen administration is thought to suppress this pituitary oversecretion. It is pointed out by the author, however, that both estrogen and androgens have been found to be of value in postmenopausal cases.

Eighty-six patients were given estrogen therapy alone. The average age of the group was over sixty. Regression of soft-tissue lesions was taken as an indication of effectiveness of therapy. Fifty-five per cent of these patients showed regression of lesions; 29 per cent showed progression; 16 per cent remained static. On separation of the patients on an age basis, regression was found to occur in 59 per cent of those over sixty, but in only 44 per cent of those under sixty. There was no significant difference in early and late menopausal cases or between nulliparae and multiparae. Results with high (20 mg. daily) and low (1–2 mg. daily) dosages were almost identical, suggesting that the lower dose is sufficient to exert maximal effect in counteracting pituitary secretion.

It was noted that primary growths responded most markedly to estrogen therapy, skin nodules less, and node metastases least of all. Bone metastases developed during treatment, requiring irradiation for relief of pain.

The author states that the most interesting observations concerned pulmonary metastases. Of 25 patients with pleural or pulmonary metastases, 9 survived twelve months, while 3 others were still alive after six months. In most of these cases regression of pulmonary lesions and pleural effusions was observed. However, 14 patients were certified as dying of lung or pleural metastases following therapy for three to four months for other metastases.

Androgen Administration: Fifty-six cases were treated by testosterone. About half of these patients were still in the premenopausal period. The analysis of these cases was again based on the control of growth of soft-tissue metastases. Of 26 cases chosen primarily on the basis of rapidly growing metastatic nodules not easily controlled by radiation, 39 per cent showed regression and 46 per cent showed progression; 15 per cent remained static.

It was noted that regression of the nodules following testosterone was unlike that which followed deep x-ray irradiation. Testosterone caused total disappearance only of the smaller nodules. The larger nodules shrunk to the level of the skin, but remained covered with a blackish, greasy crust. The prevention of distant metastases through the administration of testosterone was not accomplished, and in some cases the development of pleural effusions is said to have been accelerated. In those cases in which the patients were still cyclical, x-ray castration was used as an adjunct to testosterone.

The dosage in this group of cases was 100 to 200 mg. of testosterone implanted subcutaneously at monthly intervals. The pellet was crushed after insertion so that absorption occurred uniformly. In those cases in which such doses were unsuccessful, 100 mg. of testosterone propionate was injected twice weekly.

Ten case reports are given, showing some of the successful results.

Seven roentgenograms.

HERBERT D. KERMAN, M.D.
Oak Ridge, Tenn.

Roentgen and Steroid Hormone Therapy in Mammary Cancer Metastatic to Bone. L. H. Garland, M. Baker, W. H. Picard, Jr., and M. A. Sisson. J. A. M. A. **144**: 997–1004, Nov. 18, 1950.

This paper, representing part of a study by a Subcommittee of the Council on Pharmacy and Chemistry of the American Medical Association, is an evaluation of roentgen as contrasted to steroid hormone therapy in mammary cancer with skeletal metastases. It is the authors' opinion that clinically significant bone metastases occur in about 50 per cent of patients with recurrent or inoperable breast cancer seen on their service.

The evaluation of roentgen therapy was based on a series of 79 patients referred for treatment on the Stanford University Service at the San Francisco Hospital and at the Stanford Hospital Clinics between 1932 and 1948, with microscopically verified tumors of the breast and clear-cut roentgen evidence of bone metastases, all of whom were followed till death. Results of hormone therapy were determined in a group of 20 patients, of whom 15 had radiologically verified skeletal metastases and the remainder various pulmonary, pleural, and lymph node lesions. The experience of the Subcommittee on Steroids and Cancer in 295 patients with bone metastases is also summarized.

Numerous tables are presented showing the results of treatment. One of these comparing the effects of the two methods is reproduced here.

COMPARATIVE EFFECTS OF ROENTGEN AND STEROID HORMONE THERAPY IN TREATMENT OF OSSEOUS METASTASES

Treatment	Cases	Objective Subjective Improvement (Pain Relief), %	Objective Improvement (Roentgen Recalcification), %	Clinically Troublesome Side Effects, %	Lesions Apparently Made Worse, %
Irradiation	79*	68	26	5	0
Androgen	218†	75	16	25	0.7
Estrogen	77†	38	18	15	2.5

* Our material.
† Material of the Subcommittee.

The authors' conclusions may be quoted verbatim:

"1. About 70 per cent of patients with bony metastases from breast cancer are relieved of pain by roent-

gen therapy. This relief lasts from 50 to 100 per cent of their survival time in some three-fourths of the cases.

"2. The average survival time of patients treated with roentgen therapy appears to be very slightly prolonged. The average survival was 12 months in our group of cases, counting both the unimproved and the improved patients. A few patients apparently obtain considerable prolongation (three years or more after the first treatment of bone metastases).

"3. About 25 per cent of patients have recalcification or reossification of their bony lesions with roentgen therapy. While dramatic, this does not always indicate favorable pain relief or increased survival.

"4. The complications and side effects of roentgen therapy in moderate dosage are few and usually easily controllable.

"5. From 40 to 75 per cent of patients with bone metastases from breast cancer are relieved of pain by steroid hormone therapy, the relief being more pronounced in patients receiving androgens than in those receiving estrogens. This relief lasts for a variable number of months, the average being less in our experience than that obtained with irradiation.

"6. The average survival time of patients treated with steroid hormones was 8.8 months. It is believed that a few lives are significantly prolonged. In the group of androgen-treated patients, median survival was 8.1 months, and in the smaller group of estrogen-treated patients, 9.7 months.

"7. Ten to 20 per cent of patients who received steroid hormones have recalcification of metastases.

"8. In patients with far advanced mammary cancer, the large doses of steroid hormones used in the investigation produced numerous side effects, occasionally fatal. Some cases are considerably aggravated by therapy. Many side effects can be controlled only by discontinuance of the hormone.

"9. Whether simultaneous irradiation and steroid hormone increases or decreases comfortable life has not yet been demonstrated. It is our impression that the two weapons ought to be used serially in patients with bone metastases and only when indicated, rather than simultaneously or in combination."

Nine tables.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Consideration of the Infant in the Treatment of Cervical Carcinoma in Pregnancy. Floyd C. Atwell. Am. J. Obst. & Gynec. **60**: 1174–1175, November 1950.

The treatment of cases of carcinoma of the cervix in which the conservation of the infant is a consideration presents many difficult and unanswered problems. In such cases, seen in the latter part of the middle trimester, radium rather than deep x-ray therapy is indicated, and procedures must be used to increase the distance between the radium and the fetus.

A case report is presented of a patient treated at 28 weeks gestation with a total radium dose of 3,600 mg. hr. Prior to radium implantation an external version was done changing the position of the fetus so that its nearest surface was exposed to a calculated dose of 300 gamma roentgens. At 36 weeks gestation a classical section with a supracervical hysterectomy was done. A 4-pound, 14-ounce female infant was delivered. Except for a small halo-like area of depilation on the right parietal region, the child was normal. Seven months after delivery it exhibited a normal growth of hair, and no radiation effects were apparent.

Accumulation and evaluation of data should provide valuable information as to the amount of gamma irradiation that can safely be employed for cases in which preservation of the infant is desired.

JOHN M. KOHL, M.D.
Jefferson Medical College

Carcinoma of the Female Urethra. C. Bernard Brack and George J. Farber. J. Urol. **64**: 710–715, November 1950.

The greater number of carcinomas of the female urethra arise at the urethral meatus, from the junction of the transitional urethral epithelium and the squamous epithelium of the vulva. The lesion begins as an ulcer at the meatus often resembling a caruncle. Less frequently, the carcinoma arises from the urethral mucosa somewhere above the meatus, sometimes as a papillary growth. The urethra becomes diffusely enlarged into a hard rigid tube.

Microscopically, most urethral carcinomas are of the squamous-cell type. Prominent symptoms are burning or itching of the meatus, serous or bloody discharge, dysuria, urinary retention, incontinence, and tenesmus.

The authors report a series of 10 cases treated by radiation or a combination of radiation and surgery. Of this group, 6 were alive at the time of the report and 4 had died. Two of the 3 patients treated five years earlier were alive and well. The cases are summarized in the following table:

Case No.	Radium Therapy, mg. hrs.	X-ray Therapy, r	Operation	Result
1	2,708	5,400	Excision of urethra	Living and well, 6¾ yr.
2	3,600			Living and well, 5¾ yr.
3	3,200	2,000	Therapeutic vesico-vaginal fistula	Died 4 yr.
4	1,950	4,200		Living with recurrence 2½ yr.
5	1,100	4,000		Died 2 yr.
6	600	1,000		Living and well, 4 yr.
7	160	1,600		Died 4 mos.
8	1,200		Local excision of carcinoma	Living and well, 1 yr.
9	1,200	10,000	Excision of urethra and transplantation of ureters to colon	Living and well, 1 yr.
10	4,700	13,500	Transplantation of ureters to colon. Local excision of inguinal nodes	Died 14 mos

Two photomicrographs; 2 tables.

JOHN F. WEIGEN, M.D.
University of Pennsylvania

Roentgen Treatment and Roentgen Diagnosis of the Painful Shoulder. Paul S. Friedman. Am. Pract. **1**: 1133–1136, November 1950.

The author takes up in succession the various lesions causing shoulder pain in which roentgen treatment and diagnosis have proved most useful.

Degenerative Changes in the Cervical Spine: Pain in

the arm and shoulder frequently occurs in the presence of arthritic changes in the cervical spine. Roentgen examination may reveal a reduction or reversal of the normal cervical lordosis and narrowing of the joint spaces due to degenerative changes or hypertrophic new bone formation. Irradiation produces symptomatic relief in about 75 per cent of these cases in the absence of disk protrusion. Treatment is directed to the lower cervical and upper thoracic nerve roots through a 10-cm. portal. The dosage is 150 to 200 r every other day to a portal level of 1,000 to 1,200 r, at 160 kv. Similar treatment may be given coincidentally to the shoulder through an anterior and a posterior portal, 600 r to each. *Cervical neuritis and neuralgia* are treated similarly.

Peritendinitis, Bursitis, and Periarthritis: Acute, subacute, and chronic cases vary somewhat in their roentgen manifestations and indications for treatment. In acute cases soft-tissue calcification adjacent to the greater tuberosity of the humerus and in the vicinity of the coracoid process of the scapula or the inferior aspect of the glenoid fossa may be demonstrable. High-dose roentgen irradiation is the treatment of choice, 300 to 400 r through anterior and posterior portals with repeated treatments as indicated over a period of seven days. Over 80 per cent of the patients respond within five days or less. Subacute cases are less responsive to irradiation and chronic cases are still more resistant. The technic of treatment for lesions of all three types is outlined. In the acute cases the author has observed intensification of pain during the first twenty-four hours. [The abstracter, giving much smaller doses, has rarely had this experience.]

Arthritis: In rheumatoid arthritis roentgenograms show irregular periarticular deossification with soft-tissue swelling with subsequent reduction of the joint space. Irradiation is a valuable means of treatment in such cases, though less universally successful than in atrophic arthritis of the spine. Anterior and posterior portals are treated alternately for a total dose of 450 to 600 r per portal. Clinical response should be observed within two or three weeks. Degenerative arthritis primarily involves the acromioclavicular joint. It is manifested roentgenologically by irregularity of the joint surfaces, reduction of the joint space, and irregular hypertrophic new bone. The roentgen dosage is 600 to 900 r to anterior and posterior portals over the joint. About 50 per cent of the cases show a favorable response within two to four weeks. Tuberculous arthritis of the glenohumeral joint is similarly treated.

The author discusses also the treatment of neoplasms about the shoulder. He believes that in these cases palliation may be expected from roentgen therapy.

Four roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

RADIOISOTOPES

Place of Radioactive Isotopes in Therapy. Austin M. Brues. Am. J. Obst. & Gynec. **60**: 1009–1014, November 1950.

This concise résumé of the present-day efficacy of radioactive isotopes was presented before the American Gynecological Society. Radioactive isotopes are useful by virtue of the radiation which they give off. Their ionizing radiation may be used in therapy as one uses x-rays, radium gamma rays, or some of the newer types of accelerators.

Radioactive cobalt has been found useful as a radium substitute both as a source of external radiation and in interstitial therapy. As to its application in cervical cancer, as described by Barnes *et al.* (see following abstract), this is pioneer work, since cobalt has a homogeneous gamma radiation of different energy than radium, so that experience with the latter is not applicable. This isotope has the advantage over radium in that there is potentially a greater supply and the specific activity is potentially greater.

Injection of radioactive material into malignant tumors has not been generally employed because the variables in obtaining localization are considerable. The most remarkable example of localization of an isotope is that of iodine, which concentrates in the thyroid gland for physiological reasons. Bone concentrates radiocalcium similarly. Strontium, barium, and radium are deposited in the skeleton, since they may substitute for calcium in the structure.

Radioactive elements may be used by virtue of their deposition as colloids. If colloids of suitable particle size are administered intravenously, they will tend to show a certain pattern of concentration that varies with the size of the particle; thus it is possible to get the bulk of the radioactive colloid in the lung, liver, or spleen. This fact has been used for the purpose of directing therapy particularly to the liver or the spleen.

Despite the high relative concentration of iodine in the normal thyroid (1,000 times the average concentration in other tissues) only a few thyroid neoplasms take up useful amounts of this isotope and even in these cases it has frequently been necessary to approach total-body radiotoxic levels to gain a response. The fact that tumors may be conditioned to take up I^{131} after destruction of the normal gland, probably through mediation of the hypophysis, suggests a principle that may be useful elsewhere.

Attempts to treat osteogenic tumors by isotopes, because of their ability to concentrate in bone, have not been successful, due to the radiotoxicity to normal bone and to bone marrow associated with an adequate tumor dose.

Radioactive phosphorus is probably the most widely used agent. It is found to be most concentrated in rapidly growing tissue and cells of the blood-forming organs and bone. It has therefore been useful in the treatment of leukemia and allied disorders.

The medical future of radioactive isotopes will be largely in the field of basic biochemical research, especially in problems of growth, for which the tracer technic is ideally designed. In the treatment of carcinoma there will exist for many years the possibility of discovering radioactive compounds with special affinity for carcinoma or for particular types of carcinoma.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Use of Radioactive Cobalt in the Treatment of Carcinoma of the Cervix. Allan C. Barnes, Joseph L. Morton, and George W. Callendine, Jr. Am. J. Obst. & Gynec. **60**: 1112–1118, November 1950.

Cobalt, after activation in a nuclear reactor, forms a

relatively stable isotope (cobalt^{60}) with a soft beta ray and a homogeneous gamma irradiation which requires a minimum of shielding. It has a half life of 5.3 years and can be activated in any desired shape and form and in any desired quantity at a moderate cost. The gamma rays emitted by cobalt^{60} have a penetration equivalent to radiation from a million-volt x-ray machine from which all soft rays have been filtered.

The authors have ingeniously developed a suitable applicator for the treatment of carcinoma of the cervix by radioactive cobalt, consisting of needles, templates, and cylinders of pure cobalt.

Needle therapy has the advantage of allowing low intensity, multisource irradiation to large volumes, reducing so called "hot spots," and more homogeneous dosage. Aluminum needles of 1.27 mm. total diameter containing cylinders of activated cobalt are employed by the authors and as many as 36 needles have been used in a single applicator. From preliminary studies on dogs and from experience with the patients treated to date the authors are convinced that there is little danger of visceral or vascular injury inherent in this form of therapy. Needless to say, the needle pattern is carefully predetermined with these factors kept in mind.

To reduce needle deviation, templates have been devised which consist of a series of plastic plates each containing holes drilled for the needles. In this manner it is possible to measure the amount of radiation which will be received per hour at various points prior to placement in the patient.

All of the patients treated in this manner had received external x-irradiation initially: 2,000 r each to an anterior and posterior port, 20 × 20 cm. After the plates and needles have been prepared, they are sterilized and inserted under pentothal anesthesia. In general, the first plate carries the cervical needles, the second the paracervical, and the third the wide parametrial. The mass of templates and needles is packed in place and usually remains for six to seven days. X-ray examinations of the pelvis have indicated that the needles do not move during this time. The objective is to administer a dosage in the neighborhood of 6,000 to 7,000 tissue roentgens to the tumor.

As to results, the authors are the first to admit that no definite conclusions can be made at this time. A total of 40 patients have been treated to date, the first cervical application having been made in October 1948. Furthermore, five-year survivals are going to be of little help, since the first cases selected for cobalt therapy were already hopeless.

Systemic reactions in these patients have been no greater than in those receiving a corresponding tissue roentgen dose of radium. Dosages, however, should not be figured in millicuries or millicurie hours, since a millicurie of cobalt^{60} produces more gamma roentgens per unit time than does a millicurie of radium under identical conditions (in the ratio of 11.5 to 8.4).

The authors and the discussants emphasize the importance of preliminary roentgen therapy before penetration of carcinomatous tissue by a foreign body. In this impressive report the authors have set the stage for future exploitation of the therapeutic aspect of radioactive isotopes in the treatment of cancer.

Six figures, including 4 roentgenograms.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Some Aspects of Thyroid Disease. IV. Radioiodine in Evaluation and Treatment of Hyperthyroidism. Howard B. Hunt. Texas State J. Med. **46**: 805–808, November 1950.

The author reviews the principles of the use of radioiodine in hyperthyroidism, emphasizing an understanding of thyroid physiology and the relation of radioiodine as an indicator of thyroid physiology and iodine metabolism. He had treated 60 thyrotoxic patients with radioiodine in the past thirty months. Forty-two patients had diffuse toxic goiter and in all of them satisfactory remission occurred, although 3 required additional treatment for recurrences. Clinical remissions with reduction of goiter occurred within two or three months after one administration of radioiodine in about 50 per cent of the cases. In 2 patients a mild transient hypothyroidism developed, warranting thyroid extract for treatment.

Evaluation of results in cases of toxic nodular goiter was confused by associated cardiac damage, debility, and anxiety, but the goiter was found to shrink about one-third, with repeated radioiodine administration.

Sixteen of the 60 cases treated represented postoperative recurrences of thyrotoxicosis, and all showed good remissions on radioiodine therapy.

In the cases of diffuse toxic goiter the initial dose was 80 microcuries retained radioiodine per gram of thyroid; and in the toxic nodular goiter, 120 microcuries retained per gram of thyroid was used. Following the initial dose, a period of two months was allowed for evaluation before the administration of a second dose was considered.

No serious complications occurred in the 60 cases cited, and no evidences of gross myxedema were observed, although the basal metabolism rate occasionally dropped to −20 in a few cases. Several instances of transient aggravation of thyrotoxicosis occurred during the first two weeks following administration of radioiodine. This, the author states, can be avoided by a preceding short course of propylthiouracil or by administering fractionated smaller doses of radioiodine to critically ill patients.

It is concluded that radioiodine provides a vehicle for concentrated radiation of hyperactive thyroid tissues, and that diffuse toxic goiter responds to radiation more satisfactorily than toxic nodular goiter. Nontoxic nodular goiter should be resected because of the high incidence of carcinoma. Radioiodine in hyperthyroidism affords advantages for final remission comparable to those effected by surgery, with conservation of time, energy, and funds, and with avoidance of added anxiety, surgical risk, and hospitalization.

Three illustrations.

HERBERT D. KERMAN, M.D.
Oak Ridge, Tenn.

Pulmonary Metastatic Lesion Successfully Treated with Radioactive Iodine. Report of a Case of Pulmonary Metastasis from a Papillary Adenocarcinoma of the Thyroid. A. Stone Freedberg, Alvin L. Ureles, Mark F. Lesses, and Samuel L. Gargill. J. A. M. A. **144**: 16–19, Sept. 2, 1950.

A metastatic lesion was demonstrated in the right lung of a 14-year-old boy one year following a right hemithyroidectomy for papillary adenocarcinoma of the thyroid gland. The uptake of I^{131} in the area of the metastasis following a tracer dose was four times that of an uninvolved control area. Two months after the

administration of 78 millicuries of I^{131} the lung lesion had resolved and there was no observable concentration of radioactive iodine over the thyroid area or over the previous metastatic area. Thyrotoxicosis was not observed, and there were no toxic effects on the kidneys or blood. Two months after the first therapeutic dose, symptoms, signs and laboratory evidence of myxedema were observed. After two additional doses of radioactive iodine (a total of 137 millicuries), there was no evidence of localization or concentration of radioactive iodine within the body. At the time of the report, twelve months after the first therapeutic dose of I^{131} and seven months after the commencement of desiccated thyroid therapy, the patient was entirely well. The basal metabolic rate was −17 per cent and the serum cholesterol 238 mg. per 100 c.c. There was no evidence of metastatic recurrence in the neck, lungs, long bones, skull, or pelvis.

Four roentgenograms; 1 photomicrograph; 1 chart.

Toxic Goiter Complicating Diabetes Mellitus Treated with Radioactive Iodine (I^{131}). Barkley Beidleman. J. A. M. A. **144:** 925–927, Nov. 11, 1950.

A Negro woman, aged 43, was found in 1945 to have diabetes. The fasting blood sugar level was 344 mg. per 100 c.c. The disease was controlled well for a year and a half by diet and insulin (30 units daily). However, during the summer of 1947, the requirement of insulin began to increase and control became more difficult. The patient began to have many complaints, including a lump in the neck. The basal metabolic rate was found to be plus 70 per cent.

On hospitalization many of the signs and symptoms of thyrotoxicosis were present, including a diffusely enlarged thyroid gland. In addition, the patient was in mild myocardial failure. Bed rest and propylthiouracil were instituted, with control of the thyrotoxicosis and the diabetes.

Since the patient refused thyroidectomy, the propylthiouracil was stopped and twelve days later 8.9 millicuries of radioactive iodine were given by mouth. This was followed by an increase of the basal metabolic rate and the thyrotoxic symptoms. Twenty-four days later a left lower lobe pneumonia developed, which responded promptly to penicillin and streptomycin. Shortly after this, the thyroid gland seemed to melt away. The basal metabolic rate began to fall, and the diabetes became more stable.

Fifteen months after receiving radioactive iodine, the patient had no detectable thyroid mass. The diabetes was under good control, and there were no clinical or laboratory signs of thyrotoxicosis or myxedema.

One chart.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Lingual Thyroid: The Use of Radioactive Iodine, I^{131}, in the Diagnosis and Treatment. Kenneth R. Crispell and William Parson. South. M. J. **43:** 945–946, November 1950.

The authors present a case in which radioactive iodine, I^{131}, was used in the diagnosis and treatment of lingual thyroid. The patient, a woman of 27, had a smooth, non-tender mass in the base of the tongue about 4 cm. in its greatest diameter, interfering with swallowing. No thyroid tissue could be palpated in the normal position. Signs of hypothyroidism included dry skin and dry and brittle hair. The basal metabolism rate was −20. An oral tracer dose of 40 microcuries of radioactive iodine, I^{131}, was given and the activity at the base of the tongue and in various areas of the neck was determined by a Geiger-Müller counter; 2,475 counts per minute were obtained over the lingual mass, and 808 counts per minute over the normal thyroid site, indicating a small amount of functioning tissue at that point. The urinary excretion over a twenty-four-hour period was 86 per cent of the tracer dose, which the authors regard as within the hypothyroid range. One month later the patient was given 6.8 millicuries of radioactive iodine and was instructed to take desiccated thyroid U.S.P. 64 mg. daily. Six months later there was little if any difficulty in swallowing, and the mass at the base of the tongue had decreased in size, now measuring 3 cm. in diameter.

The effectiveness of treatment of lingual thyroid with I^{131}, as compared to surgery, remains to be proved. Certainly in this case there was symptomatic relief and some reduction in the size of the mass. Use of the isotope may reduce the incidence of hypothyroidism as a complication of treatment.

One drawing.

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Radioiodine-Accumulating Function of the Human Thyroid Gland as a Diagnostic Test in Clinical Medicine. F. Raymond Keating, Jr., Samuel F. Haines, Marschelle H. Power, and Marvin M. D. Williams. J. Clin. Endocrinol. **10:** 1425–1464, November 1950.

The radioiodine-accumulating function of the thyroid was studied by tests of several types in 790 patients with various conditions. It was found to be significantly increased in patients who had exophthalmic goiter, or adenomatous goiter with hyperthyroidism, and significantly reduced in patients who had myxedema. Significant elevation of radioiodine accumulation was also encountered in patients who had adenomatous goiter without hyperthyroidism, colloid goiter, hyperplastic thyroid nodules, and thyroid hyperplasia resulting from antithyroid drugs. In renal insufficiency, cardiac decompensation, Addison's disease, acute diffuse thyroiditis, and Riedel's thyroiditis, a significant depression of radioiodine accumulation was observed. Iodine accumulation was also found to be depressed many months after the administration of gallbladder dye. Antithyroid drugs, as well as other organic iodine compounds including desiccated thyroid, were likewise found to interfere with radioiodine accumulation.

Normal values for radioiodine accumulation were observed in most cases of adenomatous goiter without hyperthyroidism, in about half the cases of adenomatous goiter with hyperthyroidism, in a few cases of exophthalmic goiter, and in some cases of myxedema. Patients with Hashimoto's thyroiditis associated with clinical myxedema characteristically had normal values for radioiodine accumulation.

In spite of the foregoing, measurement of radioiodine accumulation was found to be a highly efficient diagnostic tool for separating more than 90 per cent of cases of exophthalmic goiter from normals. It was found to be comparatively inefficient as a method for establishing the presence or absence of hyperthyroidism in cases of adenomatous goiter. It is less useful in the diagnosis of myxedema, providing unequivocal evidence of hypofunction in about half the cases and equivocal evidence in the rest.

Four methods for measuring radioiodine accumu-

lation were compared: (1) the measurement of the quantity of radioiodine excreted in the urine within forty-eight hours after its administration; (2) determination of extrarenal disposal rate from analysis of the curve of radioiodine excretion; (3) *in vivo* measurement of the quantity of radioiodine accumulated in the thyroid twenty-four hours after administration of the dose; (4) determination of an *in vivo* accumulation rate. All four values proved similar in diagnostic sensitivity. Extrarenal disposal rate provided the clearest picture of the state of radioiodine function, particularly in situations complicated by altered renal function. *In vivo* observations provided more accurate information in the presence of reduced iodine accumulation, or its absence, than did urinary observations, but in other circumstances were less efficient, possibly owing to the intrinsic inaccuracies of *in vivo* measurements. Determination of forty-eight hour urinary excretion proved to be a less specific measure of uncomplicated hyperthyroid states than the others, and in some conditions it provided inexact and misleading information. It was, however, the simplest and least expensive of the procedures employed.

Measurement of radioiodine accumulation is considered by the authors to be comparable but not superior to determination of basal metabolic rate as a measure of thyroid function. In view of the difficulties and hazards which attend the use of radioiodine, it appears likely that it will supplement rather than supplant other diagnostic aids.

Ten tables.

Biological Half-Life of Radioactive Phosphorus in the Blood of Patients with Leukemia. I. Whole Blood—with Deviations of Observations from Predicted Values and an Estimate of Total-Phosphorus Turnover Rate. Harold Tivey and Edwin E. Osgood. Cancer **3**: 992–1002, November 1950.

II. Plasma—with Deviations of Observations from Predicted Values and an Estimate of Total-Phosphorus Turnover Rate. Edwin E. Osgood and Harold Tivey. Ibid., pp. 1003–1009.

III. Erythrocytes—with Deviations of Observations from Predicted Values. Harold Tivey and Edwin E. Osgood. Ibid., pp. 1010–1013.

IV. Leukocytes—Radioactive Phosphorus Content and the Relation to Plasma-P^{32} Levels. Edwin E. Osgood and Harold Tivey. Ibid., pp. 1014–1017.

The level of radioactive phosphorus and its variation with time in each organ and tissue of the body are held to be fundamental for the calculation of radiation dosage to that organ or tissue. The authors believe that an estimate of the concentration of radioactivity at all sites of action of the agent would be helpful in evaluating the therapeutic uses of radioactive phosphorus and in planning subsequent therapy. In four consecutive papers they report P^{32} levels and their changes with time in whole blood and its various components, namely, plasma, erythrocytes, and leukocytes,

The data for these reports were obtained from patients with chronic granulocytic or chronic lymphocytic leukemia under treatment with P^{32}. The treatment solution was injected intravenously and blood samples were withdrawn and counted by means of a Geiger counter. Correction was made for previous injections of the isotope. The rate of disappearance of radioactive phosphorus from whole blood is a simple logarithm function.

It was found that the logarithm of the level of P^{32} in the blood of leukemic patients decreases uniformly with time after the first twenty-four hours. The most probable value for the biological half-life of P^{32} in whole blood (*i.e.*, the time required for the concentration to reach one-half of any previously observed value determined after initial equilibrium had been reached) for the entire group of patients was eight days, varying among individuals from approximately five to eleven days. The zero-time (obtained by extrapolation of the logarithmic concentration curve to zero-time) in the patients with the shorter biological half-lives tends to make the amount of radiation delivered to any tissue vary, but not more than about 25 per cent. No significant difference was found in the values obtained between patients with granulocytic and lymphocytic leukemia.

The plasma radiophosphorus levels were studied in 26 patients with leukemia. The logarithm of the radioactivity decreased uniformly with time, and the biological half-life was found to be 8.5 days. The curve of disappearance of P^{32} from the plasma was parallel to the curve for its disappearance in whole blood. The authors interpret the data as indicating that non-radioactive phosphorus compounds enter and leave the plasma at such a rate that half of the phosphorus present at any one time will have been replaced by new phosphorus atoms in approximately twenty-one days.

In the erythrocyte fraction of blood, the logarithm of the level of P^{32} may be represented as a linear function of time. The median ratio of the concentration of the isotope in the erythrocyte over its concentration in the plasma was found to be 6.1:1, which agrees well with figures obtained from the literature.

In the case of leukocytes total P^{32} content was found to be approximately parallel to the mean plasma P^{32} level. The authors found that the P^{32} content of leukemic leukocytes was approximately thirty times as high as the P^{32} content of a similar volume of plasma in the same patient.

The formulae for the various calculations, statistical analysis of the results, and numerous charts are included.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Partition of Radiophosphorus (P^{32}) in Blood, Urine, and Tumor Tissue in Patients with Hodgkin's Disease and Lymphosarcoma Before and After Treatment with Nitrogen Mustard [Methyl Bis (Beta-Chloroethyl) Amine]. S. P. Masouredis, B. V. A. Low-Beer, H. R. Bierman, L. S. Cherney, and M. B. Shimkin. J. Nat. Cancer Inst. **11**: 289–300, October 1950.

The partition of tracer doses of radiophosphorus (300 microcuries) in tumor tissue, blood, and urine of patients with lymphosarcoma and Hodgkin's disease has been followed before and after the administration of nitrogen mustard. The radiophosphorus concentration-time curve over tumor and non-tumor tissue was determined by surface counting, and found to be triphasic in nature. There was a rapid rise of activity, followed by rapid decline and a leveling off of activity all of which occurred within the first sixty minutes. Activity then declined at a very slow rate over a period of days. Three of the 6 patients showed a good clinical response to the nitrogen mustard therapy and in these both the tumor and non-tumor tissue took up the radiophosphorus at a slower rate after nitrogen mustard administration. During this interval the urinary excre-

tion of radiophosphorus was greatly increased, and the plasma level of radiophosphorus remained essentially the same as that observed during the pre- and post-treatment determinations. In the remaining 3 patients studied, who did not respond clinically to nitrogen mustard, the uptake curves in tumor and non-tumor tissue and the urinary excretion of P^{32} were the same after treatment as before.

Five figures; 4 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Single Cell Autographs of Bone Marrow and Blood from Rats Using Radioactive Phosphorus. William I. Morse, 2nd. Am. J. M. Sc. **220:** 522–529, November 1950.

Single-cell autographs of marrow and peripheral blood elements are reported for the first time following the injection of P^{32} in rats. In the small number of satisfactory preparations studied, the youngest erythropoietic and granulopoietic forms from the marrow were found to have the most intense autographs, indicating rapid phosphorus turnover. Autographs of megakaryocytes and lymphocytes were faint at best.

If the observation is substantiated that the marrow elements show a more selective uptake than the lymphatic system, the author believes that radioactive phosphorus may have some advantages over roentgen irradiation in the treatment of myelogenous leukemia.

The technic of preparing single-cell autographs at present has many limitations. Desirable improvements and some applications to hematologic problems are discussed.

Eight autoradiographs; 3 tables.

Studies on the Effect of Radioactive Colloidal Gold on the Development of the Oral Structures of the Mouse. M. S. Burstone. Arch. Path. **50:** 419–426, October 1950.

Immature mice, after receiving an injection of 0.025 c.c. of radioactive colloidal gold ($gold^{198}$) along the left mandible, were killed at intervals of eight, thirteen, twenty-one, twenty-eight, and sixty days. Longitudinal sections made of the heads showed abnormalities of osteogenesis and odontogenesis, including failure of root formation. These changes were local, since roentgenograms showed absence of root formation on the injected side, whereas dental development on the opposite side was normal. The serous glands proved to be more radiosensitive than the mucous glands; the ducts were relatively radioresistant.

Similar changes have been observed in mice receiving systemic injections of radioactive phosphorus.

Radioactive $gold^{198}$ has a half-life of 2.7 days and is chiefly a beta emitter with a small component of gamma rays (15 per cent). The colloidal suspensions used in this study had an activity of 17 mc. per c.c.

Two roentgenograms; 1 photograph; 6 photomicrograph.

CORNELIUS COLANGELO, M.D.
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Plasma Iron and Saturation of Plasma Iron-Binding Protein in Dogs as Related to the Gastrointestinal Absorption of Radioiron. Charles L. Yuile, John W. Hayden, James A. Bush, Henry Tesluk, and Wellington B. Stewart. J. Exper. Med. **92:** 367–373, Oct. 1, 1950.

The absorption of a test amount of radioactive iron, during artificial saturation of the plasma iron-binding protein by the repeated intravenous injection of small amounts of iron, was measured in 3 normal and 4 anemic dogs. The procedure had no detectable influence on the iron absorption of the normal dogs nor on that of 2 of the anemic dogs. Two anemic dogs showed some suppression of iron absorption, though the amount absorbed was still in excess of that absorbed by a normal dog. The reasons for this suppression are not clear from the present experiments.

Artificially raising the plasma iron to normal levels in one anemic dog did not influence the absorption of iron from the gastro-intestinal tract nor was a delayed effect noted after the plasma iron had fallen to base line levels after five hours of artificial saturation.

It appears that the plasma iron-binding protein and its relative saturation play a slight role *per se* in the control of iron absorption in dogs.

Two tables.

Radioiron Absorption in Anemic Dogs. Fluctuations in the Mucosal Block and Evidence for a Gradient of Absorption in the Gastrointestinal Tract. Wellington B. Stewart, Charles L. Yuile, Herbert A. Claiborne, Richard T. Snowman, and George H. Whipple. J. Exper. Med. **92:** 375–382, Oct. 1, 1950.

The body's control over the absorption of iron from the gastro-intestinal tract has remained a fascinating and somewhat elusive problem in spite of considerable study. The data collected over many years and by various investigators indicate that under ordinary conditions the body carefully guards its supply of iron. The limited ability to excrete iron points to absorption controlled by some mechanism which seems to be located in the cells of the gastro-intestinal mucosa. This mechanism is in some manner linked to the amount of iron in storage, since acute anemia does not increase iron absorption whereas depletion of the iron stores effected by regeneration after acute bleeding, or associated with a chronic iron deficiency anemia, markedly increases it. In a small series of preliminary experiments it was found that absorption of an oral dose of radioiron was somewhat reduced when preceded at one to six hours by a feeding of 100 mg. of ordinary iron. It was concluded therefrom that under these conditions the mucosa could be saturated or "blocked" in a matter of hours.

The normal dog with a 50 per cent red cell hematocrit reading will usually absorb 1 to 5 per cent of standard small doses (5 to 10 mg.) of radioiron by mouth. The anemic and iron-depleted dog may absorb ten to twenty times as much.

Feeding of iron by mouth a few hours before the administration of the standard doses of radioiron was found to cause a block in the usual absorption by the anemic dog. Present studies indicate that the "mucosal block" due to iron feeding lasts only about twenty hours and that in anemic dogs it is at most an incomplete effect, since even with a short interval of five hours between feedings the amount of radioiron absorbed is four to five times greater than normal. Rapid movement of iron through the mucosa may explain the short duration of the "mucosal block" in these animals.

The colon absorbs very little iron under the conditions described. The stomach and duodenum seem to be most active in its absorption. This suggests the existence of a gradient in the capacity of the gastro-intestinal tract to absorb iron.

RADIATION EFFECTS

By-Effects of Irradiation on the Skin. Arthur William Stillians. J. A. M. A. **144:** 743–746, Oct. 28, 1950.

The author reviews some of the literature on the by-effects of both ultraviolet and roentgen radiation on the skin, mentioning infectious eczematoid dermatitis superimposed on radiodermatitis, formation of peripheral comedos following irradiation of an epithelioma, the occurrence of erythema multiforme following x-ray therapy, the occasional tumescence of senile keratosis on exposure to sunlight, and the transitory appearance of small tumors at the periphery of treated areas. He cites briefly 3 cases reported by Walter of epithelioma and papilloma arising on recently irradiated skin (Brit. M. J. **1:** 273, 1950. Abst. in Radiology **56:** 319, 1951).

In the past the author had noted small papules about the scars resulting from radiotherapy of epitheliomas. These were smooth-topped and non-tender and cleared spontaneously. Details are presented here of a case of senile keratosis (10 × 13 mm.) which had on one border an elevated linear portion similar to that commonly seen on erythematoid epitheliomas. Two applications of a radium plaque with 0.1 mm. Al filtration and at 2 mm. distance were made with a three-day interval, three erythema doses being administered at each sitting to an area 16 × 19 mm. Thirty-six days following the second application, the separation of the crust revealed a nodule 12 × 15 × 5 mm., firm, tender, and covered by red skin. Five days after this was discovered a punch biopsy was done and within two weeks the nodule had disappeared, the area subsequently showing only a smooth thin scar.

The significant pathologic features concerned the corium, which showed extensive fibrosis and inflammatory reaction, with the plasma cell the predominating inflammatory cell. Hyperplastic capillaries and obliterated arterioles were observed. The pathologist suggested that papules or nodules appearing in the periphery of an irradiated focus are not necessarily neoplastic. Their cause is not established. The author believes that they are benign and self-limited, and suggests that further histologic studies of such lesions should be made.

Four photomicrographs.

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Case of Possible Prevention of Permanent Alopecia Following Roentgen Therapy. Harry M. Robinson, Sr. Arch. Dermat. & Syph. **62:** 702–703, November 1950.

A child in whom epilation was being carried out for ringworm of the scalp was given 800 r to each of four areas. This is more than double the usual epilating dose (6 ma. were used instead of 3; all other factors were as usual). As soon as the error was brought to the attention of the author, the patient was recalled. Erythema was present, and itching was severe. Ice caps were ordered to be applied to the scalp day and night. Itching was almost immediately controlled. After three weeks, the parents were permitted to discontinue the applications except when itching occurred. The child remained completely bald for four months. At the end of that time examination with the Wood's light revealed no evidence of infection, and there were numerous short, soft, dark hairs over the surface of the scalp. At the time of the report the patient was completely well and had a satisfactory growth of hair. This good result the author attributes to prevention of the acute inflammatory reaction usually following such a dose, by the continuous application of ice.

A Lucite Syringe Shield for Protection Against Irradiation During Intravenous Administration of Beta-Emitting Radioisotopes. A. Pearl, W. F. Bethard, and L. O. Jacobson. J. Lab. & Clin. Med. **36:** 792–794, November 1950.

Attention is called to the danger of overexposing the hands to beta radiation during therapeutic intravenous administration of beta-emitting radioisotopes. A lucite syringe shield is described. It consists of a cylindrical lucite barrel into which the syringe fits and locks by a 90-degree turn. The wall is 1.2 cm. in thickness and protects against beta particles with maximum energies as high as 2.0 mev. A conical compression spring, inserted at the bottom of a hole bored in the shield, holds the syringe firmly in place after it has been inserted and twisted into the groove at the top of the shield. This device is designed to accommodate many standard types of syringes and reduces the need for elaborate decontamination procedures, since simplicity of assembly obviates contamination of the shield by radiation and of the syringe by bacteria.

Two photographs; 1 drawing.

Hematology of Atomic Bomb Casualties. George V. LeRoy. Arch. Int. Med. **86:** 691–710, November 1950.

During the period of August to December 1945 numerous hematological studies were done on Japanese injured by the atomic bombs exploded over Hiroshima and Nagasaki. The studies were made on persons presenting evidence of radiation injury such as epilation, purpura, vomiting on the day of the blast, ulcerative oropharyngeal lesions, and bleeding tendencies other than purpura. Others were included in the study because of their proximity to the blast. Attempts were made to correlate blood pictures, clinical evidence of radiation injury, and distance from the blast (dose of radiation received).

With severe radiation injury, a severe leukopenia of 50 to 1,000 cells was present within a few days after the bombing, and in these patients, death usually occurred within a few days. If the patient survived beyond the first few days, the leukopenia increased until the 4th week and thereafter returned to normal. The granulocytes returned to normal by the ninth week, whereas the lymphocytes had not reached normal by the twelfth week. It was noted that the critical period for patients with severe radiation injury who did not die in the first week was the third to the fifth week. During this time, also, the specific signs of radiation injury appeared, epilation on about the twenty-first day and purpura on about the twenty-fifth day.

A thrombocytopenia of less than 25,000 was in 10 out of 13 cases associated with death, whereas thrombocyte counts of 50,000 or over were not followed by death.

Bleeding and clotting times increased directly and markedly with the degree of leukopenia, whereas such

changes were less striking and less constant with thrombocytopenia.

The syndrome of radiation injury has a typical clinico-hematological picture. In general, the severity of the leukopenia corresponded with the severity of the clinical symptoms. Thrombocyte count changes and leukocyte count changes ran parallel courses. The onset and severity of a hemorrhagic tendency closely followed the variations in the thrombocyte count.

Alterations in red cell count were less consistent and less useful than were the degree, onset and evolution of the leukopenia in evaluating radiation injury In general, the greater the dose of radiation, the more profound and rapid the blood damage and the slower its repair. Knowledge of serial variation in the leukocyte count of a victim of radiation injury is of great clinical importance; it is doubtful whether the other elements of the hemogram are of comparable significance.

Twenty-one tables; 7 charts.

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Effect of Lymphoid Necrosis Due to Nitrogen Mustard and Roentgen Irradiation on Neuromuscular Function of Hypophysectomized Animals. Clara Torda and Harold G. Wolff. Am. J. Physiol. **163**: 201–208, October 1950.

After removal of the pituitary gland neuromuscular function is impaired, due mainly to a dysfunction of the nerve element. Two measurable components of the dysfunction of a neuromuscular system are a decline of action potential during repetitive stimulation of the nerve, a sign of easy fatigability, and decrease of acetylcholine synthesis by nerve tissue. Both the action potential and the acetylcholine synthesis return to normal during administration of adrenocorticotrophic hormone (ACTH) to hypophysectomized animals. Hence, it is inferred that the fatigability of nerve is regulated *in vivo* through the ACTH output of the pituitary gland, though the mechanism of such regulation is not yet identified. It is known, however, that the mass of lymphoid tissue and thymus is reduced during ACTH administration. In the authors' experiments an attempt was made to decrease the mass of lymphoid tissue and thymus to a degree comparable to or more complete than the decrease induced by administration of ACTH.

In the absence of measures with exclusive effect on the mass of lymphoid tissue and thymus, the effect of ACTH was approximated or exaggerated by using two agents instead of one, namely, roentgen irradiation and nitrogen mustard. These two measures differ in their side effects from each other and from ACTH.

Hypophysectomized rats were given 150 r in air (140 kv., 25 cm. distance, 3 mm. aluminum shield) for three minutes, twice in a seventy-two-hour interval. The animals were killed two days after the second treatment. Other hypophysectomized rats were injected endoperitoneally once with concentrations of nitrogen mustard from 0.4 to 2.0 mg./kg. of body weight, and were killed two days later. The completeness of the removal of the pituitary gland was established at autopsy. Unoperated rats served as controls.

It was found that roentgen irradiation and administration of nitrogen mustard increased acetylcholine synthesis in hypophysectomized rats about 30 per cent and increased by about 30 per cent their ability to maintain the amplitude of action potential during repetitive stimulation. Administration of ACTH restored in hypophysectomized rats the acetylcholine synthesis and the ability to maintain the amplitude of action potential to normal. The authors conclude that the effect of ACTH in improving the function of nerve is probably dependent only in part on the reduction of the mass of thymus (perhaps also the lymphoid tissue).

One illustration; 3 tables.

Pyridoxine and Experimental X-Radiation Injury in Rats. M. L. MacFarland, M. V. Peters, R. M. Ballantyne and E. W. McHenry. Am. J. Physiol. **163**: 394–399, November 1950.

To investigate a possible relationship between pyridoxine insufficiency and x-ray injury, the effects of total body irradiation on pyridoxine-deficient rats and on animals receiving this factor were compared.

All animals used in the study were young albino rats. Five groups received pyridoxine-deficient diets; control animals were given a daily supplement of 40 μg. of pyridoxine hydrochloride. After a preparatory period during which the deprived animals developed symptoms of pyridoxine deficiency, total body exposure to x-rays was carried out (100 to 500 r). All doses were administered in a single exposure with the following physical factors: 200 kv., 20 ma., 50 cm. skin-target distance, 20 × 20-cm. field, 0.25 mm. Cu filter, approximately 33 r per minute.

Under the experimental conditions employed in these investigations, the degree of injury sustained by rats receiving severe total body irradiation did not appear to bear a relationship to their state of pyridoxine nutrition. The effects of exposure were not accentuated by previous pyridoxine deprivation, and measurements of the hepatic stores of total vitamin B_6 did not indicate that loss of this factor had been increased in irradiated animals.